



INSTRUCTIONS

INSPECTIONS AND CHECKS

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INTRODUCTION

This section covers inspections and checks on a diesel-electric locomotive. Inspection is a critical examination to detect any problems such as hanging wires, anything that is loose and other damages. Specific inspection intervals are determined by each railroad. The items included in this manual may fall under the one-month, three-month, six-month or twelve-month inspection schedule depending on local procedures. The only tools needed for inspecting most items are a flashlight and a rag.

There are two important distinctions among checks. The first is a functional check; performing a function to determine if the item is functional and ready for operation. This includes looking at the dipstick, gages, dials, meters, the oil and water levels, etc. The other is an operational check; determining if a piece of equipment is operating under operating conditions: for example, determining if the air compressor provides compressed air.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

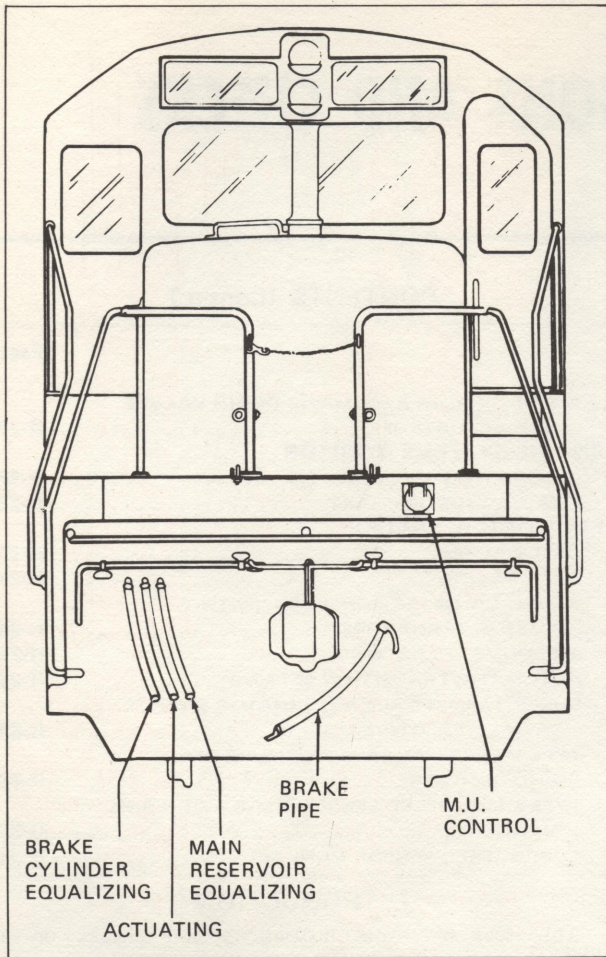


FIG. II-1. LOCOMOTIVE END CONNECTIONS.

A test is different from a check in that it is measuring the operational parameters of equipment under operating conditions. It should be noted that test information is not included in this section. Refer to the Trouble-Shooting section.

EQUIPMENT AND APPARATUS LOCATION

EQUIPMENT LOCATION

Locomotive End Connections

The locomotive end connections are shown in Fig. II-1.

Electrical Equipment Compartments

The Series-7 Locomotives have standardized on two electrical equipment compartments, Fig. II-2, to house control equipment and to provide for the maximum separation of high and low voltages.

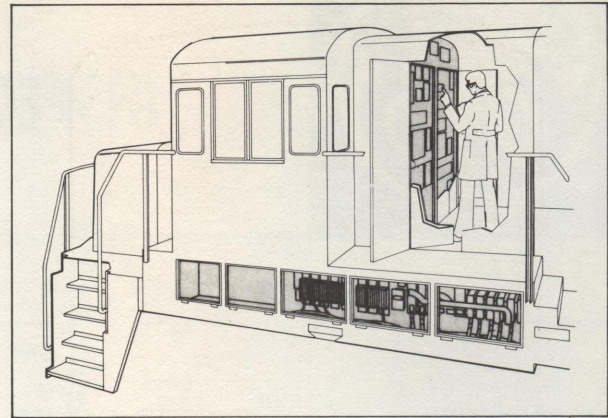


FIG. II-2. ELECTRICAL EQUIPMENT COMPARTMENTS (LOWER AND UPPER).

Lower Compartment

All high-voltage heat-emitting power equipment such as contactors, reverser and braking switch remain in the lower control compartment, Fig. II-2. This arrangement features adequate space for customer options plus improved ventilation.

Upper Compartment

All low-voltage, low-heat producing control components are located in the upper compartment, Fig. II-2, providing a spacious area for component maintenance. The compartment also contains a secondary air filter to protect these components. Fig. II-3 presents the upper compartment equipment arrangement.

No. 2 End Equipment Arrangement

The Series-7 Locomotives, Fig. II-4, have five significant modifications to improve reliability and availability, and to reduce maintenance and operating costs.

1. The compressor has been moved from the radiator compartment into a walled-off section of the engine room where it breathes warm air. This new environment isolates the unit from road dust, eliminates oil and oil vapor from the radiator compartment and lessens the chance of winter freeze-up.
2. The water tank, with improved pressure retention, has been redesigned using copper bearing steel to eliminate flake rust. The new rectangular tank no longer supports the oil cooler, thus reducing the tendency to crack.

FIG. II-3, E-24522

FIG. II-4, E-24523

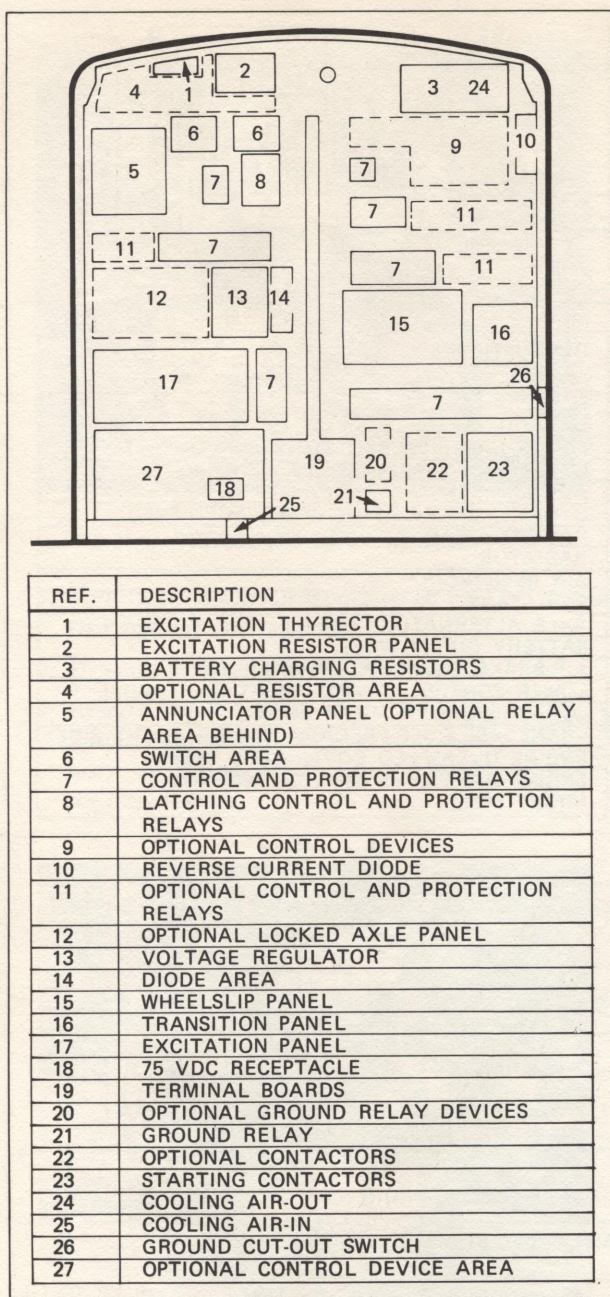


FIG. II-3. ELECTRICAL CONTROL COMPARTMENT EQUIPMENT ARRANGEMENT.

- The oil filter has been repositioned to permit self-draining – the dirty oil must flow out. Ten filter elements are now utilized instead of eight to increase the time between necessary filter changes.
- The oil cooler is self-supporting and is now mounted to allow easy draining, etc. With a simplified piping arrangement, the unit is now easier to drain and clean, and has greater resistance to plugging.

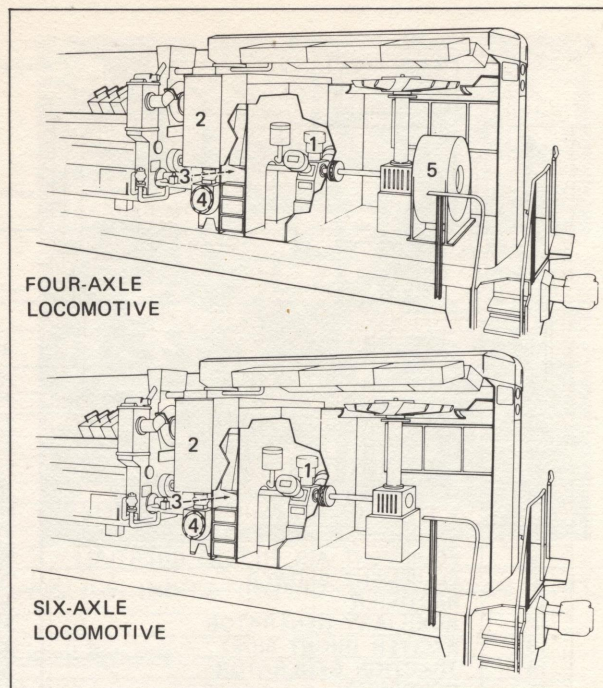


FIG. II-4. NO. 2 END EQUIPMENT ARRANGEMENT.

- In the four-axle locomotive, the equipment blower has been moved into the radiator compartment to make room for the AAR cab modifications and the new location for the low-voltage control compartment.

APPARATUS LOCATION

The apparatus location is shown in Fig. II-5.

TRIP INSPECTION, SET-UP AND SERVICING

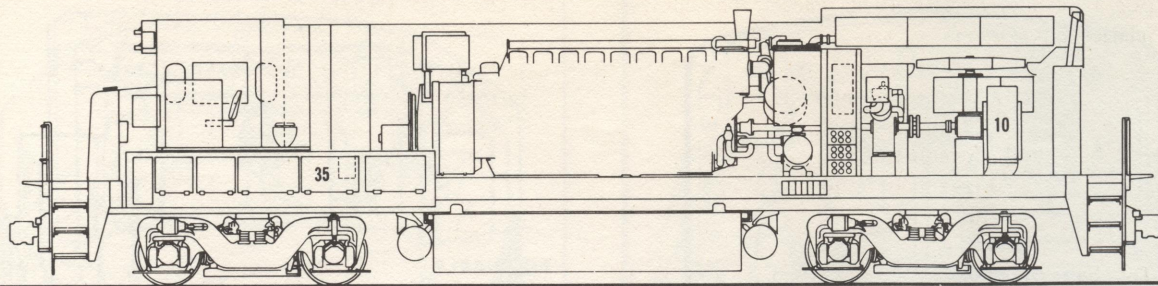
DESCRIPTION

“Trip Inspection, Set-Up and Servicing” refers to the procedure to be followed each time a locomotive or a multiple-unit consist of locomotives is serviced and set-up for its next assignment.

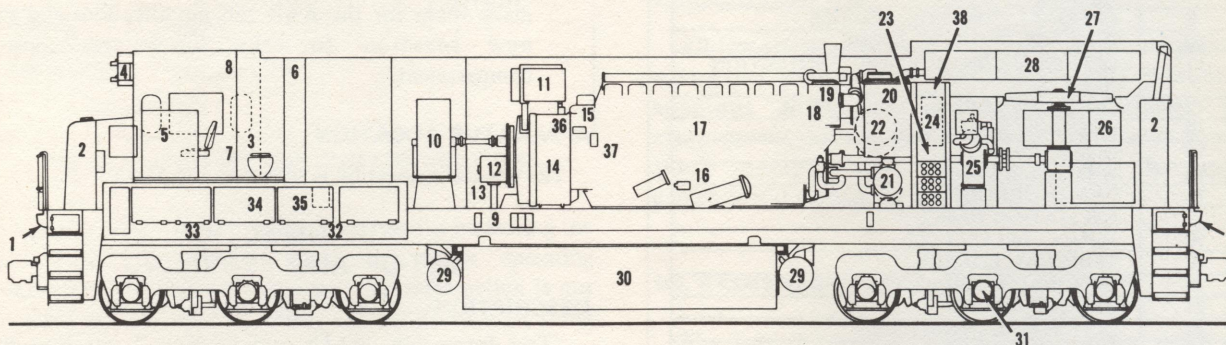
“Inspection” is the visual checking of components on the locomotive for signs indicating possible system problems such as leaks, incorrect valve positions and loose, damaged or broken parts.

“Set-Up” is the proper positioning of switches, circuit breakers, cut-out cocks and valves for direction and type of service the locomotive is to be applied on next assignment.

“Servicing” includes the checking of, and if low, the adding to fuel oil, engine lubricating oil, cooling water, sand and supplies for any other systems.



REF.	DESCRIPTION	REF.	DESCRIPTION
1	MULTIPLE-UNIT CONNECTOR	20	COOLING-WATER STORAGE TANK
2	SAND BOX	21	LUBE-OIL COOLER
3	TOILET (WHEN FURNISHED)	22	LUBE-OIL FILTER
4	HEADLIGHT AND NUMBER BOXES	23	ENGINE AIR FILTERS (INERTIAL)
5	OPERATING CONTROLS	24	ENGINE AIR CLEANERS (PAPER)
6	UPPER CONTROL COMPARTMENT	25	AIR COMPRESSOR
7	WATER COOLER (WHEN FURNISHED)	26	DYNAMIC BRAKE GRIDS (WHEN FURNISHED)
8	ENGINE CONTROL PANEL	27	RADIATOR FAN
9	EQUIPMENT AIR FILTERS (INERTIAL)	28	RADIATOR
10	EQUIPMENT BLOWER	29	AIR RESERVOIR
11	RECTIFIER	30	FUEL TANK
12	AUXILIARY GENERATOR	31	AXLE ALTERNATOR
13	EXCITER (RIGHT SIDE)	32	BATTERY (RIGHT SIDE)
14	TRACTION GENERATOR	33	AIR-BRAKE EQUIPMENT (RIGHT SIDE)
15	GOVERNOR	34	LOWER CONTROL COMPARTMENT (LEFT SIDE)
16	FUEL-OIL TRANSFER PUMP, STRAINER AND FILTER	35	CONTROL COMPARTMENT FILTER
17	DIESEL ENGINE	36	CRANKCASE OVER-PRESSURE SWITCH (RIGHT SIDE)
18	INTERCOOLER	37	ENGINE OVERSPEED GOVERNOR'S RESET
19	TURBOCHARGER	38	ENGINE AIR FILTER SERVICE INDICATOR (RIGHT SIDE)



NOTE: RIGHT AND LEFT SIDE DESIGNATIONS ABOVE ASSUME SHORT CAB "F" END.

FIG. II-5. APPARATUS LOCATION (FOUR-AXLE AND SIX-AXLE LOCOMOTIVE).

Proper performance of these trip inspection, set-up and servicing procedures could reduce the number of road failures by recognizing and correcting faults before the locomotive is released for further service.

The trip inspection, set-up and servicing procedures are divided into two groups:

1. Electrical items
2. Mechanical items.

ELECTRICAL ITEMS

Included in this group are electrical items on a General Electric locomotive that should be checked during a trip inspection, set-up and servicing procedure.

Assume in all cases the engine is idling and the locomotive independent air brakes are properly set.

The following inspection sequence assumes maintenance personnel board the locomotive at the cab end, enter the cab, proceed along the right-side of the locomotive and then exit the locomotive at the rear and, if in multiple-unit consist, proceed to the next locomotive.

Operator's Control Console

For Lead or Trail operation the proper positioning of the three-handle Master Controller on the operator's control console, Fig. II-6, is:

FIG. II-6, E-25103

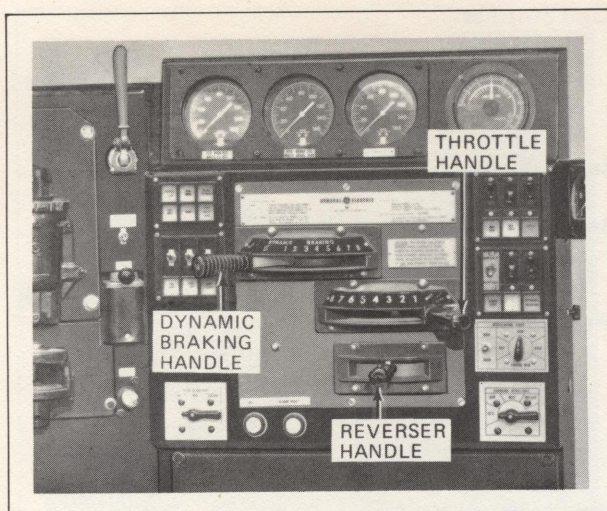


FIG. II-6. OPERATOR'S CONTROL CONSOLE.

1. Throttle handle in IDLE position on the Lead unit (in OFF position on Trail units).
2. Dynamic Braking handle in OFF position.
3. Reverse handle removed. (Depending on local operating procedure, it is assumed the operator will insert the Reverse handle when he is ready to operate the locomotive.)

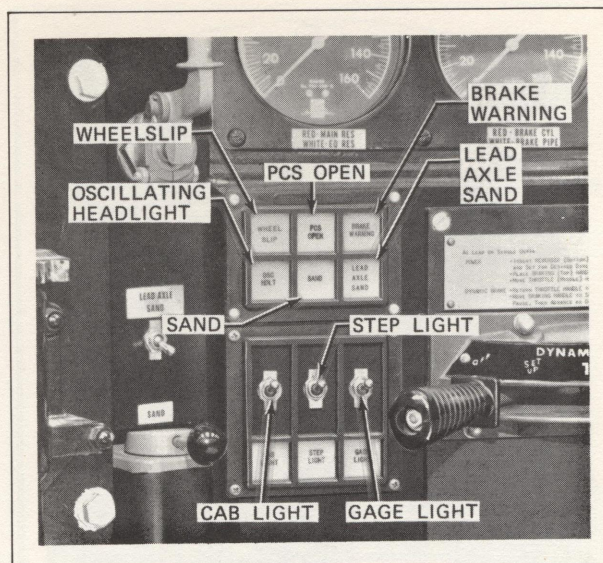


FIG. II-8. INDICATING LIGHT AND SWITCH PANEL.

Circuit Breakers

Position the circuit breakers, Fig. II-7, when operating as follows:

Circuit Breaker	Lead Unit	Trail Unit
ENGINE RUN	ON	OFF
GENERATOR FIELD	OFF	OFF
CONTROL	ON	OFF
POWER LIMIT	NORMAL (OFF)	NORMAL (OFF)
DYNAMIC BRAKE	ON	OFF

For safety reasons, the Generator Field circuit breaker on the Lead locomotive is left in the OFF position until the operator desires power to move the locomotive and/or train.

On the Lead locomotive, the operator should move the Power Limit circuit breaker to NOTCH 7 position only while the locomotive is under power, with the Master Controller Throttle handle in Notch 8 and with the locomotive encountering excessive wheelslip. Placing this breaker in NOTCH 7 will reduce the power output of the Lead locomotive only. The Power Limit breaker should be returned to the NORMAL (off) position as soon as the rail condition will permit full power operation on the Lead locomotive.

Indicating Lights

Assure that none are lit, Fig. II-8, when the locomotive is at standstill and the engine is at IDLE. For example: A lit WHEELSLIP light would indicate a malfunction which should be corrected.

FIG. II-7, E-25104

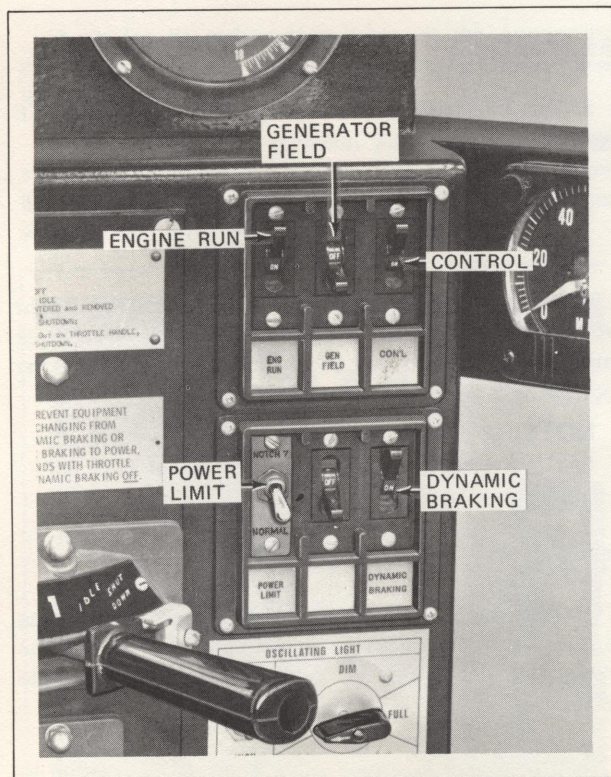


FIG. II-7. OPERATOR'S CONTROL CONSOLE CIRCUIT-BREAKER PANEL.

FIG. II-8, E-25105

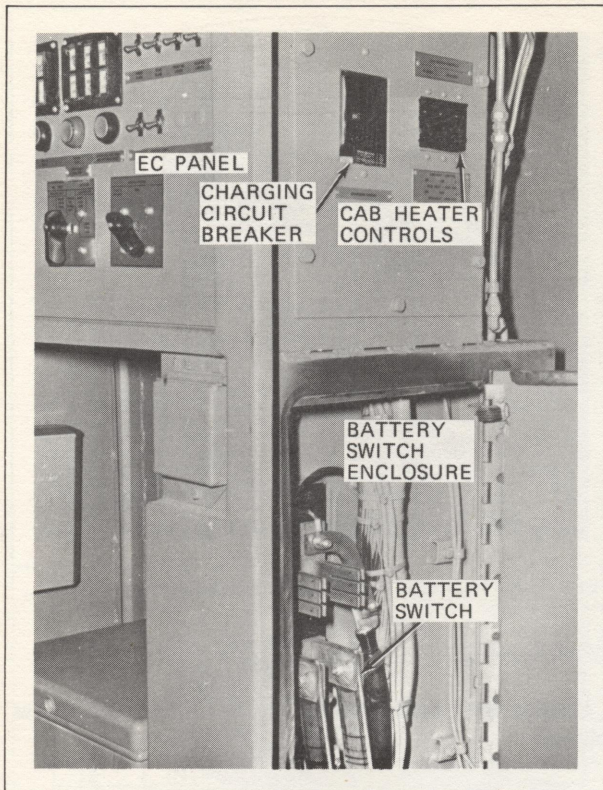


FIG. II-9. ENGINE CONTROL PANEL SHOWING BATTERY SWITCH AND CHARGING CIRCUIT BREAKER.

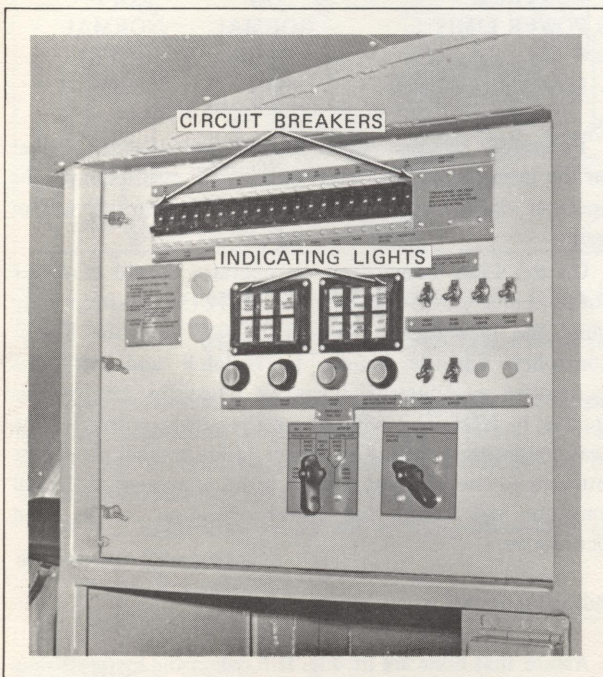


FIG. II-10. ENGINE CONTROL PANEL SHOWING CIRCUIT BREAKERS AND INDICATING LIGHTS.

Light Switches

Those on the Switch Panel should be positioned according to the railroad instructions.

Engine Control Panel

Battery Switch

The Battery switch, Fig. II-9, must be CLOSED on all locomotives in the multiple-unit consist.

NOTE: *The polarities of the blades on the Battery switch are not always consistent. On most General Electric locomotives, the left blade is negative and the right blade is positive.*

Charging Circuit Breaker

This breaker, Fig. II-9, must be ON at all times while locomotives are in service.

Circuit Breakers

Position the breakers, Fig. II-10, according to the directions on the instruction strip mounted above the circuit breakers. The instruction strip gives the proper position of each breaker for Lead or Trail operation.

Indicating Lights

Set the Engine Control switch to the START/ISOLATE position.

NOTE: *On some locomotives several of the indicating lights are de-energized when the Engine Control switch is set at the RUN position.*

Assure no indicating lights, Fig. II-10, are lit since a light would signify a problem exists on the locomotive, which must be investigated and should be corrected before the locomotive is released for further service.

NOTE: *If any malfunction lights are lit, refer to the ENGINE SYSTEMS MONITOR (ESM) section and review the ESM Diagnostic Chart.*

Set-Up Switches

Position the M-U Headlight switch, Fig. II-11, according to the direction and position of the locomotive in the consist. The switch instruction plate describes the available positions.

Set the Engine Control switch in the RUN position to place the locomotive "On Line" for normal operation. The switch is shown in the START/ISOLATE position.

FIG. II-9, E-25106

FIG. II-10, E-25107

FIG. II-11, E-25108

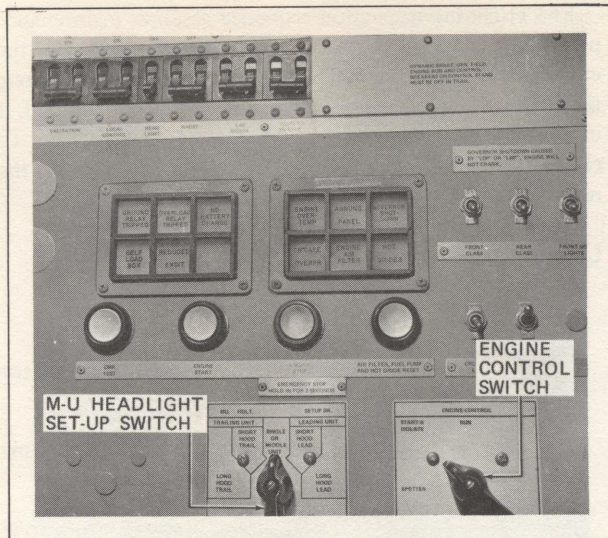


FIG. II-11. ENGINE CONTROL PANEL SHOWING SET-UP SWITCHES.

NOTE: The *SPOTTER* position on this switch is a customer option to provide battery power for movement of the locomotive in the shop using one traction motor.

Annunciator Panel

Check for lit malfunction lights on the Annunciator Panel, Fig. II-12, located within the control compartment. Resolve the malfunction problem.

After resolving the problem, place the Reset Toggle switch to the RESET position. Test for any burned-out light bulbs by pushing the LAMP TEST push-button. Replace any burned-out bulbs.

FIG. II-12, E-25109

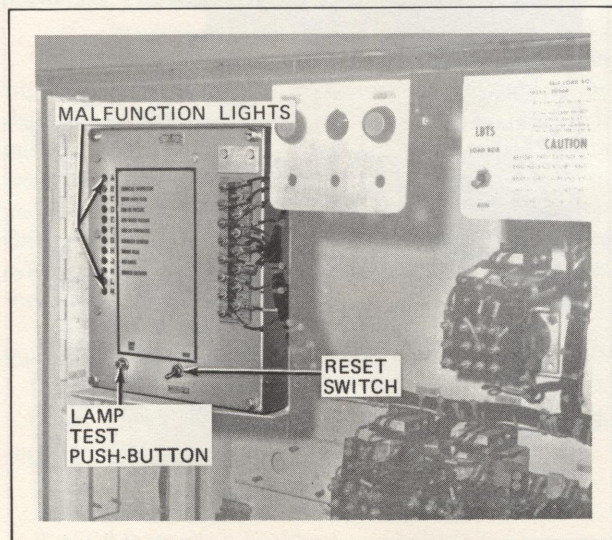


FIG. II-12. ANNUNCIATOR PANEL.

FIG. II-13, E-11821

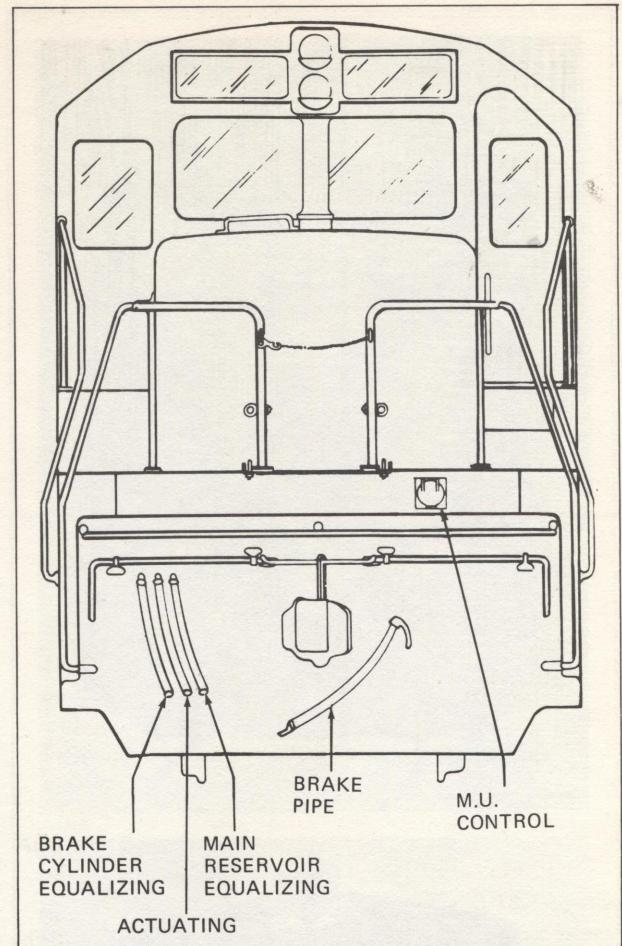


FIG. II-13. MULTIPLE UNIT (M-U) JUMPERS.

NOTE: If any malfunction lights are lit, refer to the *ENGINE SYSTEMS MONITOR (ESM)* section and review the *ESM Diagnostic Chart*.

Multiple-Unit Jumper

Check that the jumpers, Fig. II-13, between locomotives of the consist are properly secure in their receptacles and properly suspended to prevent chafing or damage.

MECHANICAL ITEMS

Description

Included in this group are mechanical items on a General Electric locomotive that should be checked during a trip inspection, set-up and servicing procedure.

Assume in all cases the engine is idling and the locomotive independent air brakes are properly set.

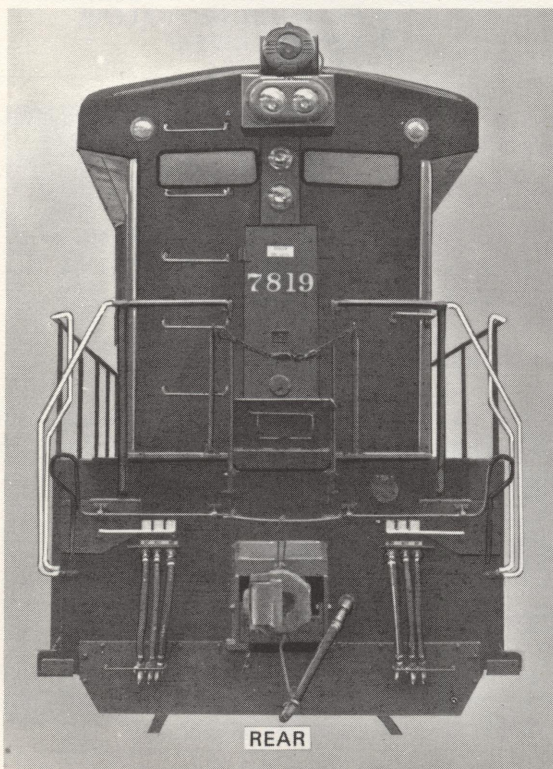


FIG. II-14. LOCOMOTIVE ENDS.

The following inspection sequence assumes maintenance personnel board the locomotive at the cab end, enter the cab, proceed along the right-side of the locomotive, along the left-side and then exit the locomotive at the rear and, if in multiple unit consist, proceed to the next locomotive. To check devices below platform level on the return from the rear of the consist, refer to "Ground Level Inspection."

Locomotive Ends

Perform the following:

1. Check for damage or irregularities to the end of the locomotive, Fig. II-14.
2. Check the condition of the coupler and uncoupling levers.
3. Check M-U air hoses between locomotives of a consist for proper connection. Assure the hoses are not cross-connected.
4. Check the cut-out cocks on the brake pipe and M-U hoses (behind end frame) to insure they are fully OPEN between locomotives and properly positioned on end locomotives.

Sand Traps

The sand trap Shut-Off handle, Fig. II-15, should be in the OPEN position. Sand delivery hoses should be smooth, not collapsed and properly clamped. The trap clean-out flange must be in place and tight.

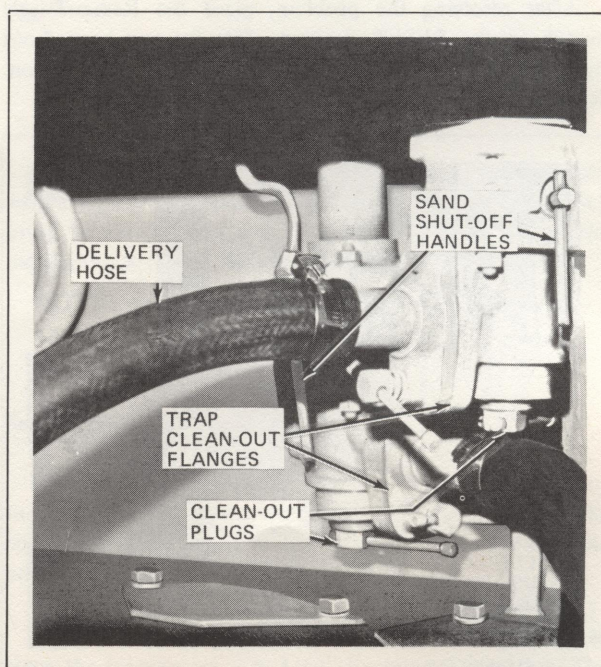


FIG. II-15. SAND TRAPS.

FIG. II-14, E-25110

FIG. II-15, E-25111

FIG. II-16, E-25112

FIG. II-17, E-25113

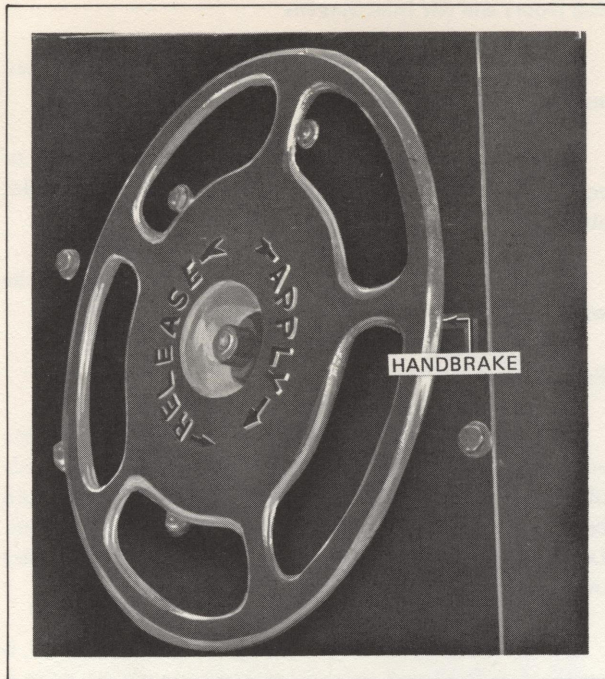


FIG. II-16. HANDBRAKE.

Air supply cut-out cocks to the sand traps must be OPEN.

NOTE: Air supply cut-out cocks are usually located near the ceiling of the sand trap compartment just inside the spring-loaded step door.

Handbrake

Local railroad operating procedures determine when the handbrake, Fig. II-16, is to be applied or released.

On three-axle C trucks, check that the handbrake chain trips the brake cylinder Quick-Release valve located on the right-side of the Lead truck. Air should be heard as it is released from the brake cylinder. The quick-release feature releases air pressure from the brake cylinder on one axle to insure the mechanical handbrake is holding the locomotive. Only in this way, if air pressure bleeds-off the brake cylinder, will the handbrake still hold the brake shoes firmly against the wheel.

Engine Control Panel Gages

Check the Engine Control Panel gages, Fig. II-17, with engine at IDLE. The gages should read:

- Turbo Air Pressure — zero (0)
- Fuel Oil Pressure — 40 psi
- Lube Oil Pressure — between 15 and 25 psi

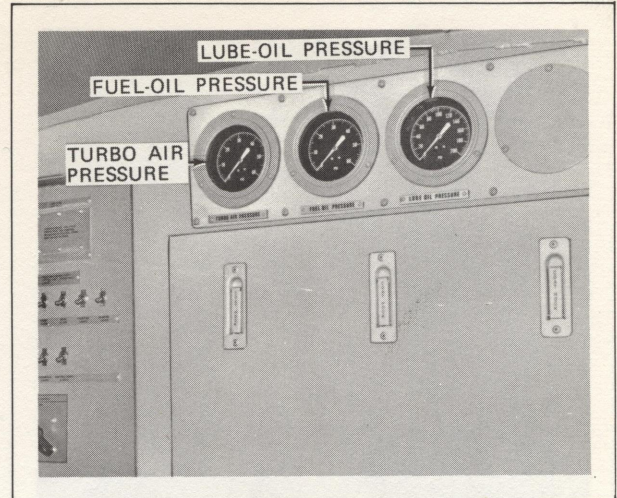


FIG. II-17. ENGINE CONTROL PANEL GAGES (SHOWN AT ZERO; ENGINE SHUTDOWN).

NOTE: Maximum turbo air pressure occurs only at Notch 8 with the engine producing full horsepower. Maximum turbo air pressure will range between 20 and 32 psi depending on the particular model of locomotive. Turbo air pressure is negligible in Notches 1 through 5, even under load.

Air Brake Gages

Check that the air brake gages, Fig. II-18, on the operator's control console are indicating the proper values. The main-air reservoir gage normally should indicate 130 to 140 psi on the Lead locomotive.

Trail units in a consist equipped with special two-stage compressor governor control should normally have 135 to 145 psi main-air reservoir pressure indicated on the gage.



FIG. II-18. AIR BRAKE GAGES (SHOWN AT ZERO; ENGINE SHUTDOWN).

FIG. II-18, E-25114

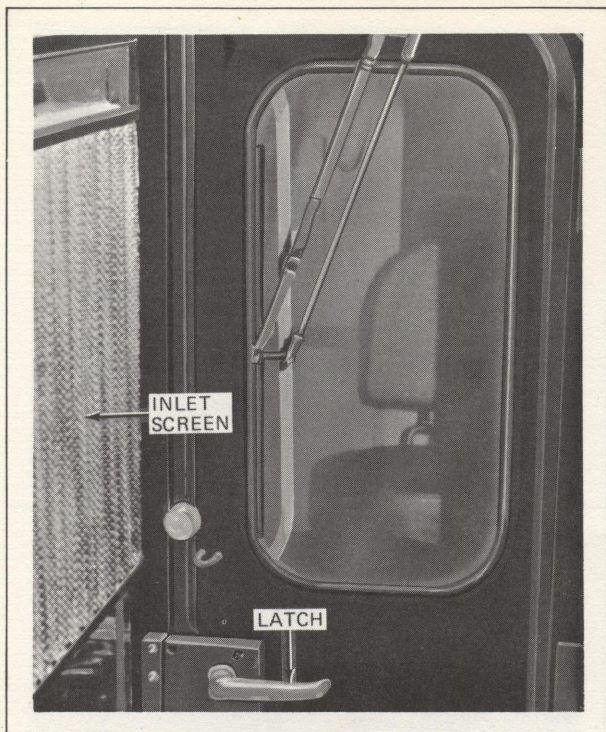


FIG. II-19. CAB DOORS AND AIR INLET SCREENS.

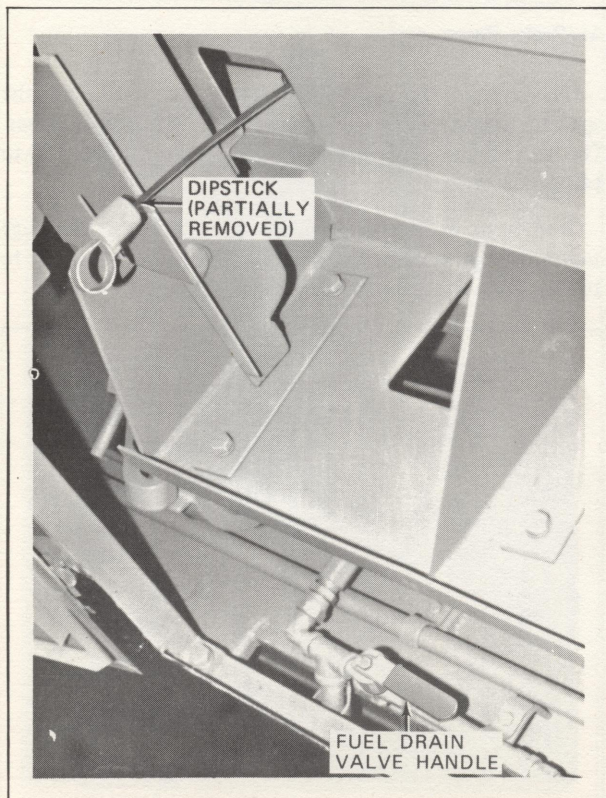


FIG. II-20. ENGINE DIPSTICK AND FUEL DRAIN-VALVE HANDLE.

Cab Doors and Air Inlet Screens

The cab door latch, Fig. II-19, must hold the door closed and the door must seal properly.

Remove accumulated debris from the outside of equipment blower, engine air intake, and radiator-cab inlet air screens.

Also, check the wipers for proper pressure against the windshield.

Engine Oil Level

Check the diesel-engine lubricating oil supply with the engine at IDLE. The dipstick, Fig. II-20, located on the side of the engine is marked LOW - FULL. The oil level should be above the LOW mark, but not above the FULL mark. DO NOT OVERFILL. Excess oil can cause a crankcase overpressure shutdown.

The floor-mounted, fuel drain-valve handle, Fig. II-20, is on the fuel filter tank drain valve. The spring return valve is normally held closed. If fuel pressure build-up is restricted due to air trapped in the lines, opening the spring return valve may release trapped air and restore proper fuel pressure. Open the valve with the fuel pump running, then check that it closes properly.

Check for Engine Leaks

While checking the engine oil level, Fig. II-21, also check the engine for leaks or any unusual condition. For example: This could possibly be a melted intake air manifold section or a broken fuel rack linkage. These conditions must be repaired before dispatching the locomotive for road service.

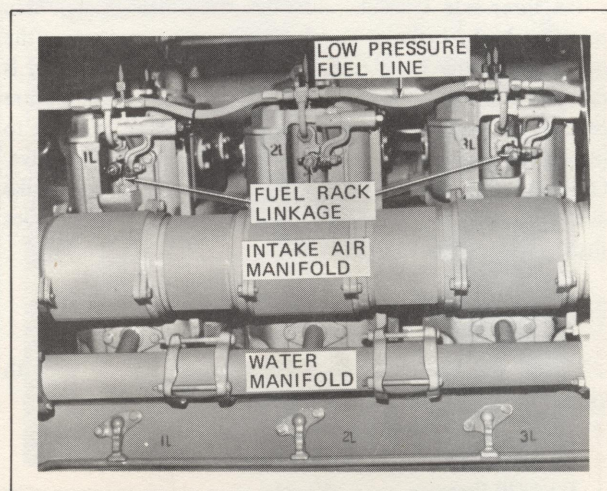


FIG. II-21. ENGINE DETAILS.

FIG. II-19, E-25115

FIG. II-20, E-25116

FIG. II-21, E-25117

FIG. II-22, E-25118

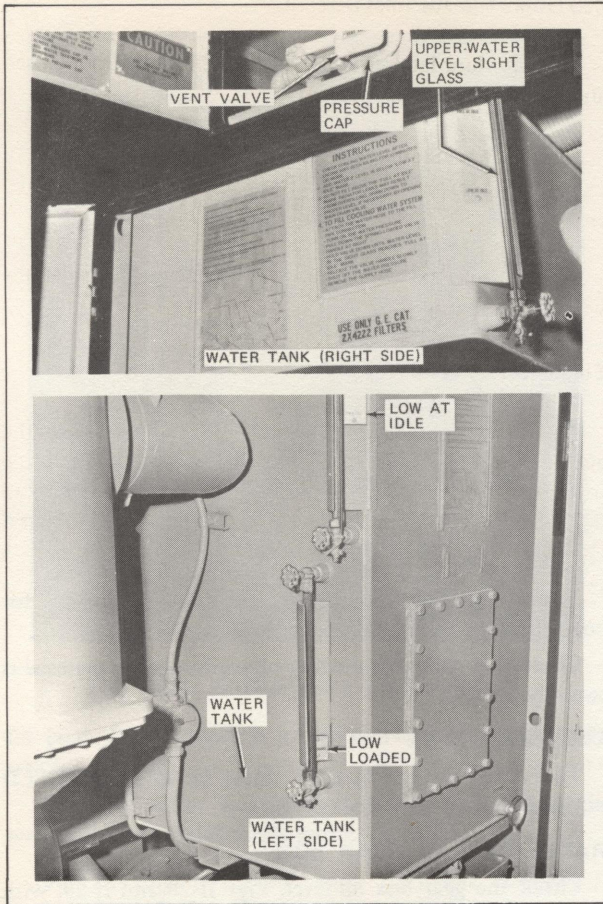


FIG. II-22. WATER STORAGE TANK.

Engine Cooling Water Supply

The water storage tank, Fig. II-22, contains the cooling water for the diesel engine. With the engine at IDLE, the level in the water tank sight glass should be above the LOW AT IDLE mark on the tank indicating plate. Be sure both the top and bottom sight glass valves are open.

While checking the water level, inspect around the tank area for leaks. Serious leaks may require repair before the locomotive is released for service.

If water must be added, inspect the entire cooling system for leakage, especially around the radiator area. Also, check that the water pressure cap is on tight. Instructions for adding water and adding water-treatment compound are mounted on the storage tank.

NOTE: The LOW AT IDLE reading can be obtained on either side of the storage tank. The LOW LOADED mark is located only on the left-side of the storage tank.

Check for Leaks

While checking the engine cooling-water supply, also check the water system drain valve, Fig. II-23, to assure it is completely closed.

FIG. II-23, E-25119

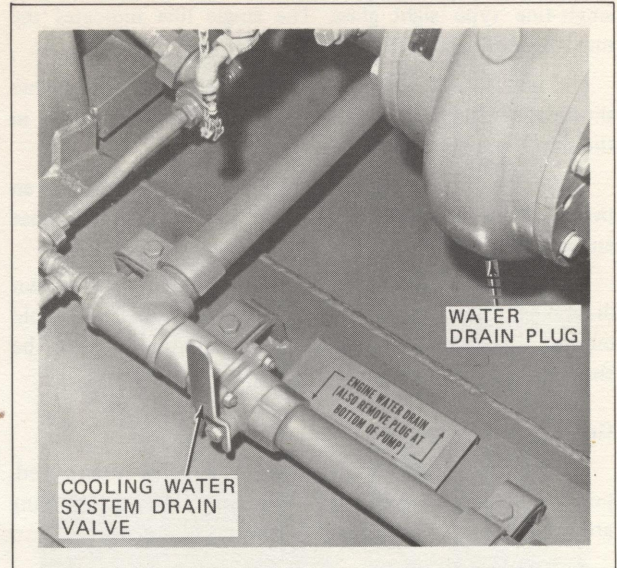


FIG. II-23. COOLING-WATER SYSTEM DRAIN VALVE.

A drain valve slightly open may result in a total loss of the cooling water.

NOTE: Engine water and air compressor water drain through one valve.

Also, check the water pump area for water, oil and fuel leaks.

Engine Governor

Check the engine governor oil, Fig. II-24, with the engine in IDLE. The Series-7 Locomotive governor uses the

FIG. II-24, E-25120

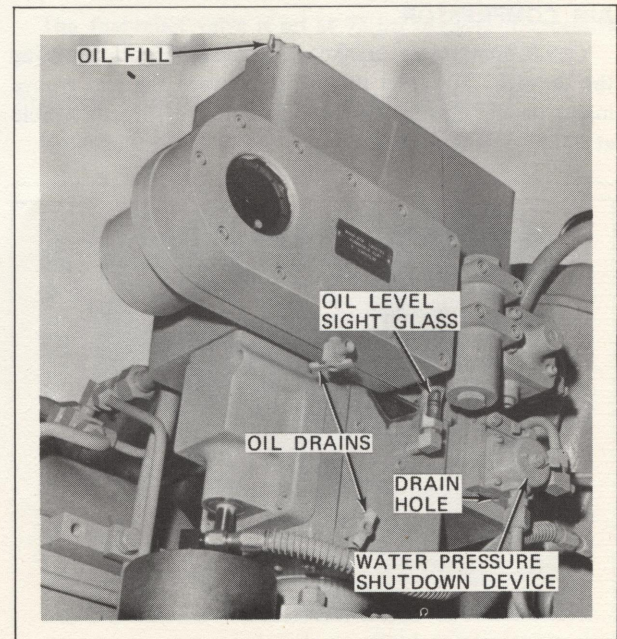


FIG. II-24. ENGINE GOVERNOR.

single-line type sight glass. The single line indicates the maximum oil level with the engine at IDLE.

Oil will be visible in the sight glass with the engine shutdown. Usually, the governor will appear overfilled in the shutdown condition.

Tests have been conducted that have shown that an overfilled or underfilled governor can sometimes cause engine "hunting." Hunting is not a desirable condition.

Also, check the engine water-pressure shutdown diaphragm drain hole. Water leaking from this hole indicates a failed diaphragm. The diaphragm should be changed to avoid a possible future road shutdown.

Ground Level Inspection

After the on-board inspection has been completed, perform a ground level inspection, Fig. II-25, by walking around the entire consist and check items such as:

1. Trucks
 - a. Brake shoes
 - b. Brake cylinders and levers
 - c. Handbrake equipment
2. Fuel tank for damage or leaks.
3. Locomotive sump drains for leakage. Leakage from the drains may be a result of system leakage on-board the locomotive. These leakages should be investigated.
4. Air reservoirs for damage or leaks.
5. Hanging equipment or material from the locomotive to the roadway.

MECHANICAL INSPECTION

AIR COMPRESSOR

Check compressor crankcase oil level, Fig. II-26, using the dipstick. The level should be between the two groove marks on the dipstick with the locomotive Throttle handle at IDLE.

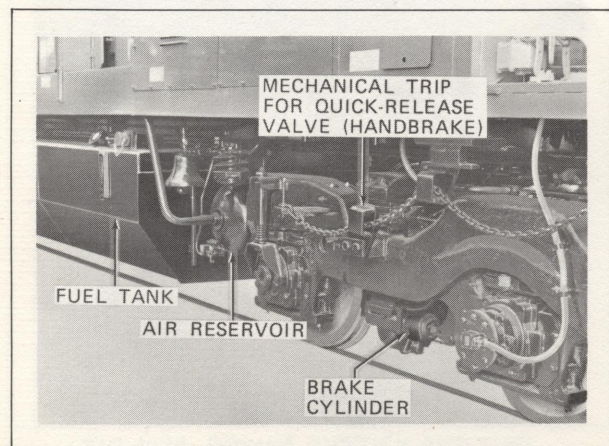


FIG. II-25. GROUND LEVEL INSPECTION.

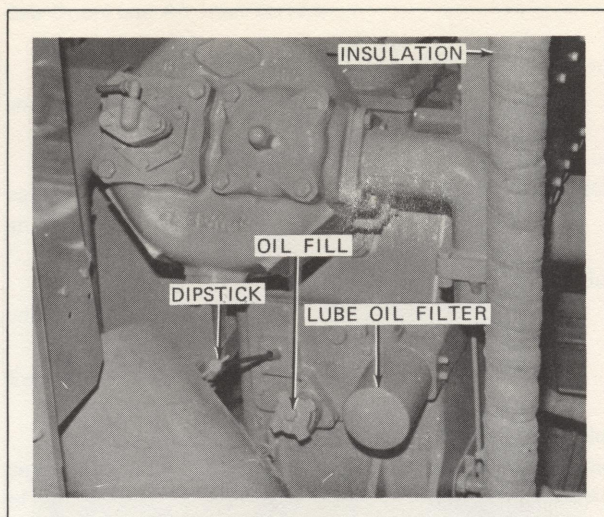


FIG. II-26. AIR COMPRESSOR.

Inspect the air compressor and immediate area for compressor oil or cooling water leaks.

Check that compressor water-piping insulation material is securely applied.

LUBE-OIL DRAIN VALVE

The drain valve, Fig. II-27, must be in the CLOSED position (turned fully clockwise).

RADIATOR FAN GEAR BOX

Check the gear box oil level, Figs. II-28 and II-29, with the engine shut down. The oil should be up to the lip of the

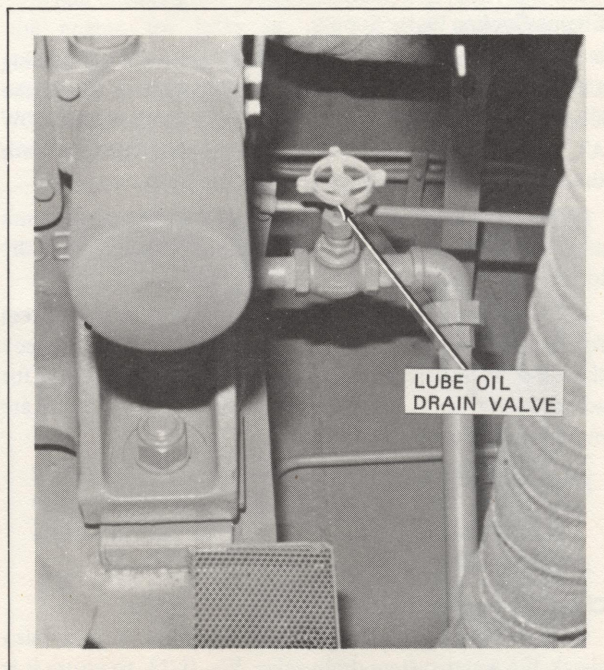


FIG. II-27. LUBE-OIL DRAIN VALVE.

FIG. II-25, E-25121

FIG. II-26, E-24483

FIG. II-27, E-24484

FIG. II-28, E-24485

FIG. II-29, E-12825A

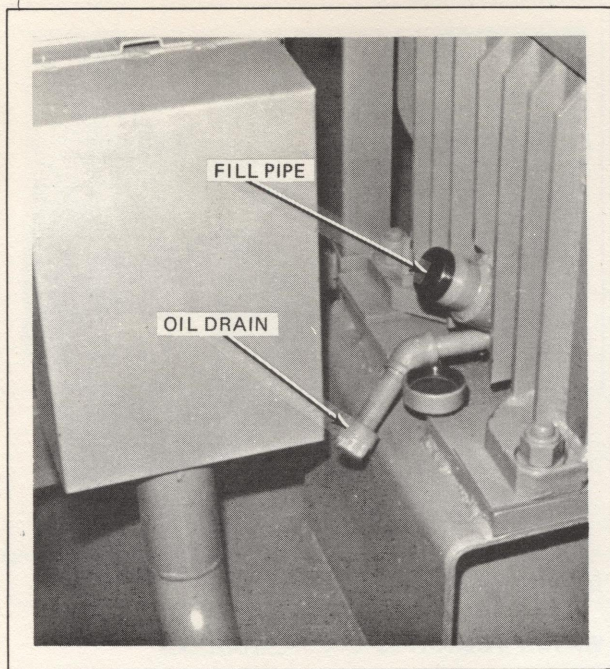


FIG. II-28. RADIATOR FAN GEAR BOX.

fill pipe. (No dipstick is provided.) Inspect the gear box area for oil leaks.

Check for water treatment stains on, and around, the gear box. These stains might indicate a radiator leak.

NOTE: *Engine cooling water does not normally flow through the radiators at IDLE. Pressurization of the water system may be required to locate radiator leaks.*

GENERATOR GEAR UNIT LUBRICATING OIL

The generator gear unit dipstick, Fig. II-30, is marked on one side for the correct oil level with the engine running at IDLE; the other side indicates the correct oil level with the engine shut down.

The oil drain is located about 12 in. below the dipstick. The drain plug is not shown.

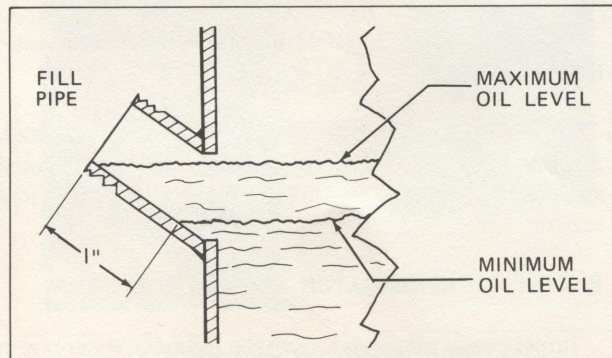


FIG. II-29. OIL LEVEL.

FIG. II-30, E-24486

FIG. II-31, E-24487

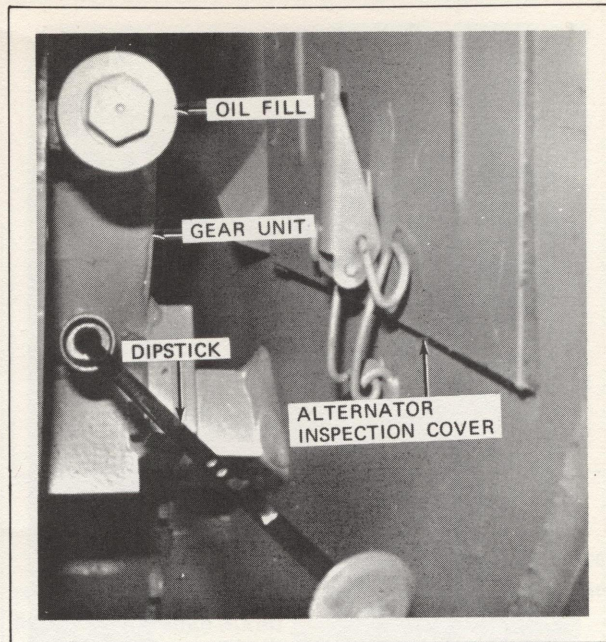


FIG. II-30. GENERATOR GEAR UNIT.

Check that the alternator inspection covers are correctly applied.

FUEL SYSTEM

Inspect the fuel pump, strainer, relief valve, regulator and related piping, Fig. II-31, for leaks. Replace filter elements as designated. Check transfer-pump motor brushes for proper length. The fuel regulator is set to give 40 psi at IDLE on the gage located in the operator's cab.

The fuel-relief valve is set at 75 psi to prevent excessive pressure in the fuel system.

ENGINE LUBRICATING OIL-PUMP AREA

Inspect oil-pump area piping for leaks, Fig. II-32.

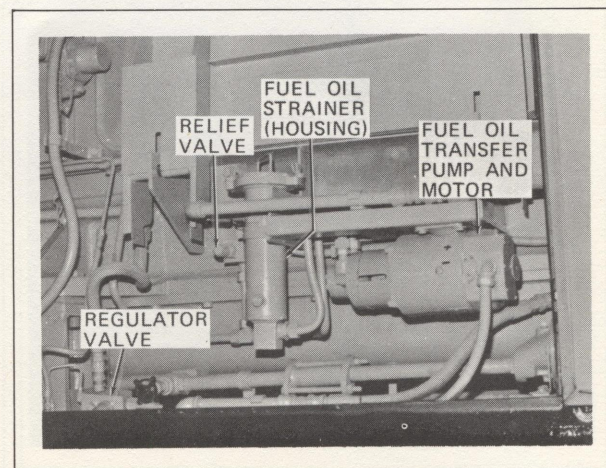


FIG. II-31. FUEL SYSTEM AREA.

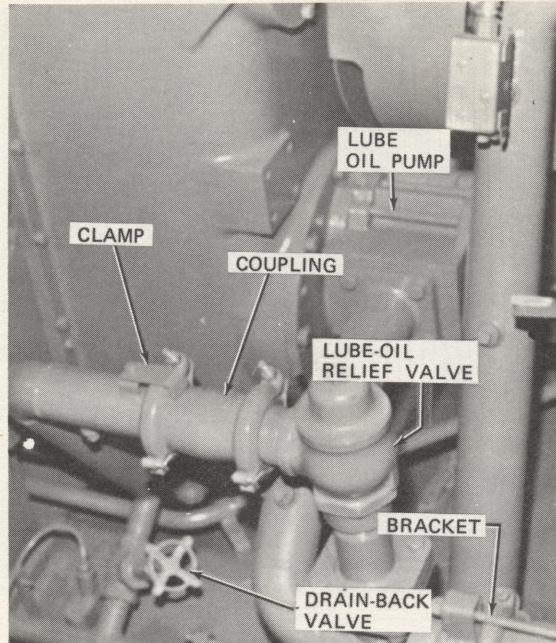


FIG. II-32. ENGINE LUBRICATING OIL-PUMP AREA.

Check that oil filter tank drain-back valve is CLOSED.

Check that the Dresser coupling brackets and clamps are secure. Without the clamps, normal engine vibration can cause the couplings to move on the piping. Excessive movement could cause major leakage and a road failure.

The oil relief valve opens at 135-140 psi to prevent excessive lube-oil system pressures.

OIL DRAIN VALVES

Close crankcase and filter drain valves, Fig. II-33, for normal operation.

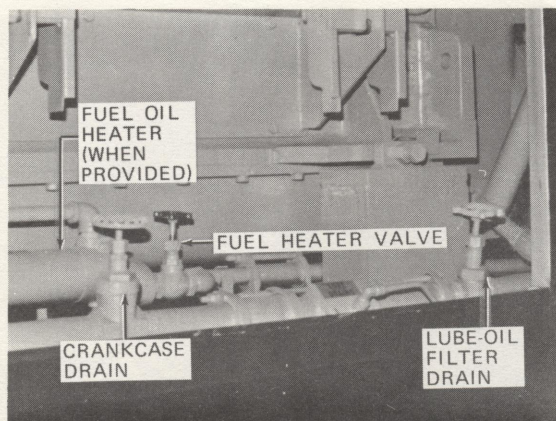


FIG. II-33. OIL DRAIN VALVES.

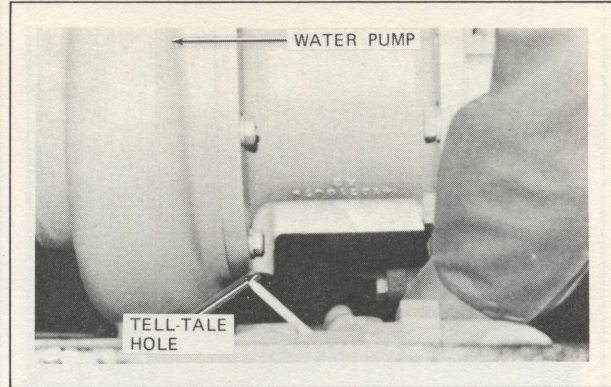


FIG. II-34. WATER PUMP AREA.

For summer operation, close fuel heater water valve.

For winter operation, open fuel heater water valve.

Inspect the engine block for oil, water or fuel leakage from the cylinder area.

WATER PUMP

Leakage from the water pump tell-tale hole, Fig. II-34, indicates a defective pump seal. The pump should be replaced or the seal renewed. In most cases engine cooling water will be leaking from the tell-tale hole indicating a defective water seal. If the oil-seal becomes defective, oil will also come out the tell-tale hole.

NEVER PLUG THE TELL-TALE DRAIN HOLE. With this drain plugged, a defective water pump seal would permit water to contaminate the engine crankcase oil.

Leakage from the tell-tale hole may be permitted for a short while after starting a cold engine. However, if the leakage continues after the engine has reached operating temperature, the seal may be defective.

CHECK FOR LEAKS

Inspect low and high-pressure fuel oil tubing, piping and hoses, Fig. II-35.

Inspect the water manifold that feeds the cooling water into the cylinders.

Inspect the intake air manifold for leaks or irregularities. A leak might be detected visually by an exposed air-manifold O-ring. This could indicate a loose manifold section.

ENGINE COOLING-WATER RETURN MANIFOLD

Inspect each elbow between the cylinder water-return port and the water-return manifold for leaks, Fig. II-36.

FIG. II-32, E-24488

FIG. II-33, E-24489

FIG. II-34, E-24491

FIG. II-35, E-24492

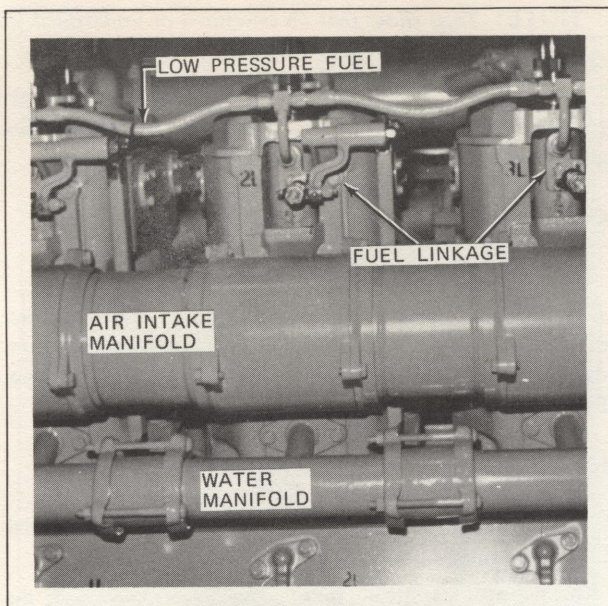


FIG. II-35. ENGINE DETAILS FOR MECHANICAL INSPECTION.

Exhaust Manifold

Check the condition of the exhaust manifold, Fig. II-36. Check for missing or loose bolts, or connections. With the engine idling, manifold leaks can be detected by pulling out the corresponding fuel-injection pump rack. This overfuels (the cylinder causing black smoke that escapes through any manifold leaks). Excessive carbon deposits on the engine may indicate a leaking manifold.

FIG. II-37, E-24494

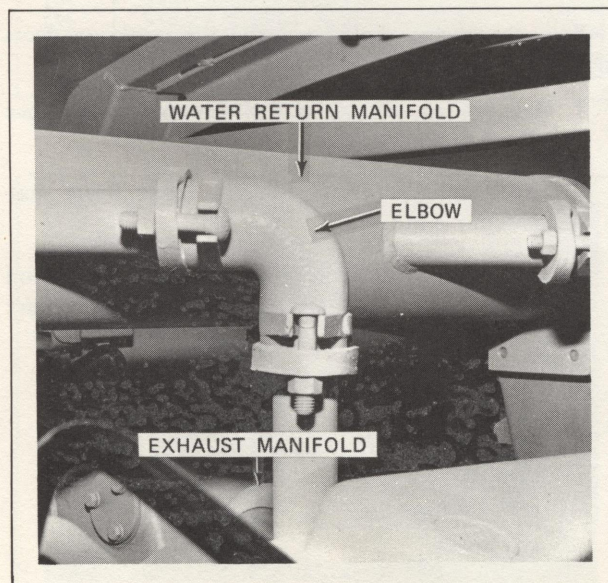


FIG. II-36. ENGINE COOLING-WATER RETURN MANIFOLD.

FIG. II-38, E-24495

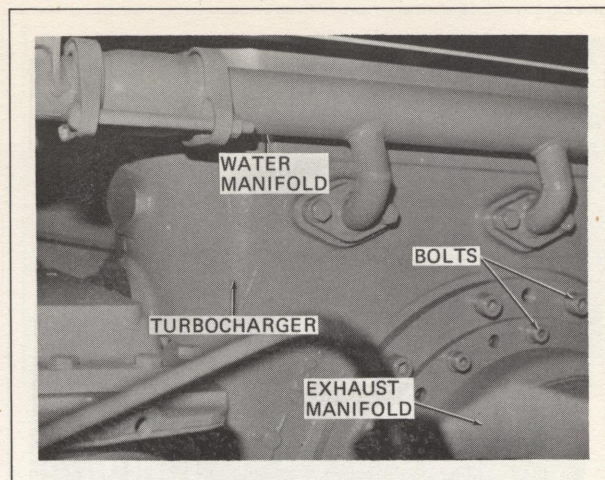


FIG. II-37. TURBOCHARGER AREA.

All leaks should be corrected. Excessive leakage can reduce the turbocharger speed which reduces engine horsepower output.

TURBOCHARGER

Check the cooling-water return manifold, Fig. II-37, for leaks.

Check the exhaust manifold to turbocharger connection for exhaust leaks, Fig. II-37. Check that all clamping bolts are in place and tight.

EXHAUST-STACK ASPIRATOR HOSE

Inspect the flexible metal-aspirator hose connections, Fig. II-38. Replace any broken metal hose.

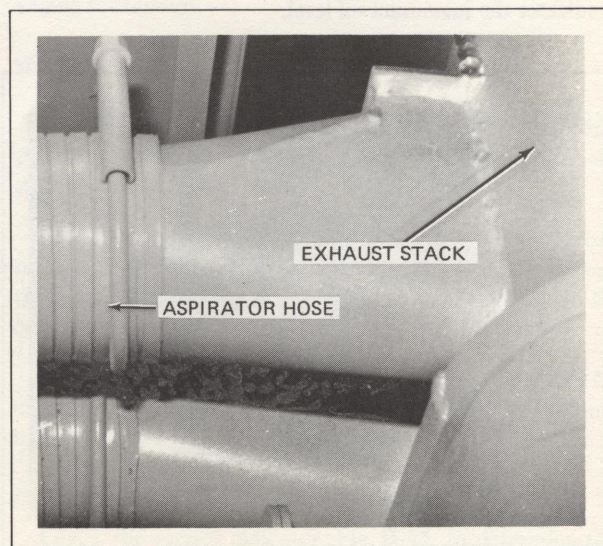


FIG. II-38. EXHAUST-STACK ASPIRATOR HOSE.

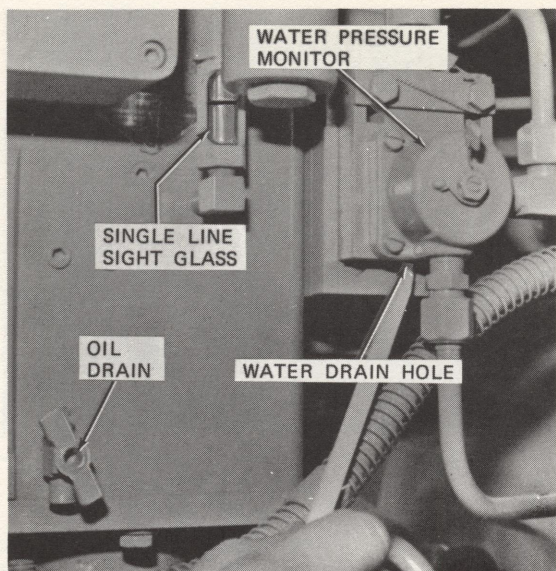


FIG. II-39. ENGINE GOVERNOR AREA.

The hoses can be partially viewed from the locomotive walkways. The hinged hatch covers should be lifted for a complete inspection.

NOTE: Broken aspirator hose will partially disable the engine intake air-cleaning system.

ENGINE GOVERNOR

Oil Level

Engine governor oil is checked with the engine at IDLE. The governor sight glass is a single-line sight glass, Fig. II-39: One line is etched on the glass. The single line indicates the maximum oil level.

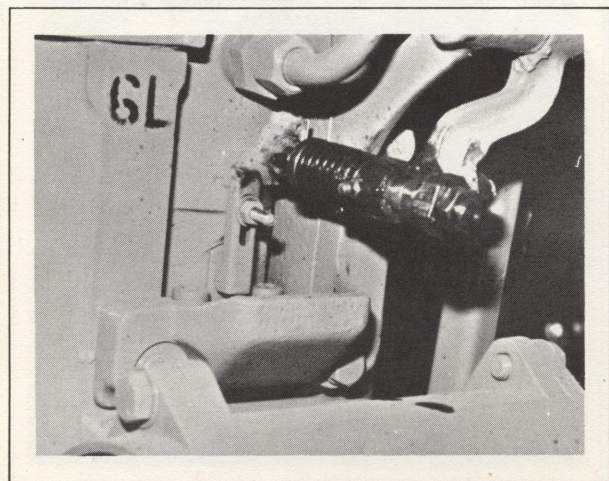


FIG. II-40. INJECTION FUEL-PUMP LINKAGES.

NOTE: Tests show that an overfilled or underfilled governor can cause undesired engine heating.

Governor oil must be clean and of the proper type. Replace dirty oil. Do not use engine crankcase oil in the governor.

Check For Leaks

Check the governor oil and water piping for leaks.

Inspect the engine cooling-system water-pressure monitor/shutdown device, Fig. II-39. Water leakage from the drain hole would indicate a defective water diaphragm. Replace defective diaphragm.

INJECTION FUEL-PUMP LINKAGES

Inspect Linkage, Fig. II-40, for binding or excessive looseness.

Add grease to fitting only when the linkage is in the IDLE, or higher position. If lubricated at the shutdown position, grease will not enter the groove.

UPPER CYLINDER EQUIPMENT

Inspect valve stems, springs, bell crank, push rods, rocker arms and tappet adjustment nuts, Fig. II-41, for proper lubrication and any irregularity.

With the engine at IDLE, observe oil flow from the rocker arms. Listen for any abnormal sounds that might indicate worn parts.

CRANKCASE

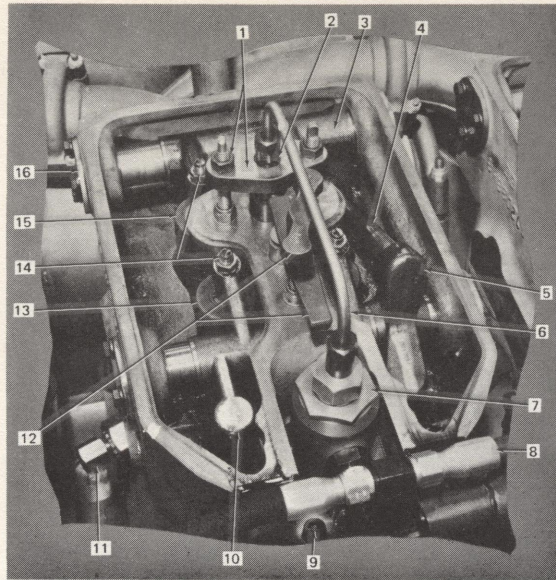
With the engine shut down and the crankcase doors removed, Fig. II-42, inspect:

1. Main bearing and rod cap-side clearances for evidence of heat or bearing wear.
2. Lower cylinder liners. Broken lower liners may indicate a bent rod.
3. Main or connecting rod. Nicks or gouges in the rod may result from a bent rod that is hitting the cylinder liner.
4. Camshaft lobes for wear.
5. Crosshead rollers for wear.
6. Camshaft bearings. Look for irregularities.
7. Internal engine-frame ledges. An accumulation of metal bearing material on these ledges may indicate a failed main or rod bearing.

FIG. II-39, E-24496A

FIG. II-40, E-24497

FIG. II-41, E-14991A



REF.	DESCRIPTION
1	FUEL-INJECTOR NOZZLE CLAMP BAR AND HARDWARE
2	FUEL-INJECTOR NOZZLE
3	EXHAUST-VALVE ROCKER ARM
4	EXHAUST-VALVE CROSSOVER PUSH ROD
5	BELL CRANK
6	HIGH-PRESSURE FUEL LINE
7	FUEL-INJECTION PUMP
8	FUEL HEADER LINE
9	INJECTION-PUMP MOUNTING BOLT
10	INLET-VALVE ROCKER ARM
11	COMPRESSION RELEASE PLUG
12	CYLINDER-COVER CLAMP BAR AND HANDLE
13	INLET-VALVE SPRING
14	VALVE TAPPET ADJUSTMENTS
15	EXHAUST-VALVE SPRING
16	ROCKER-SHAFT RETAINER PLATE

FIG. II-41. UPPER CYLINDER EQUIPMENT.

FIG. II-42, E-24499

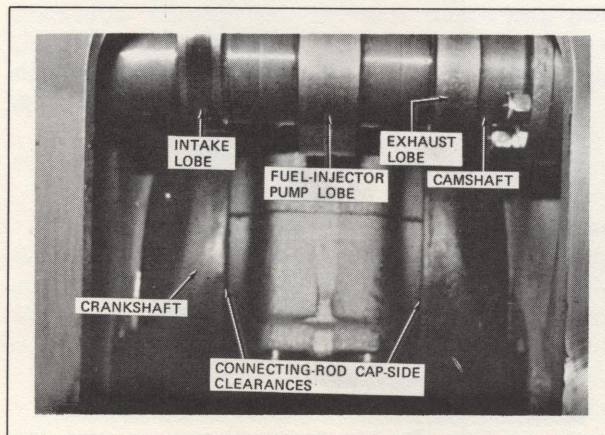


FIG. II-42. CRANKCASE AREA.

FIG. II-43, E-24500

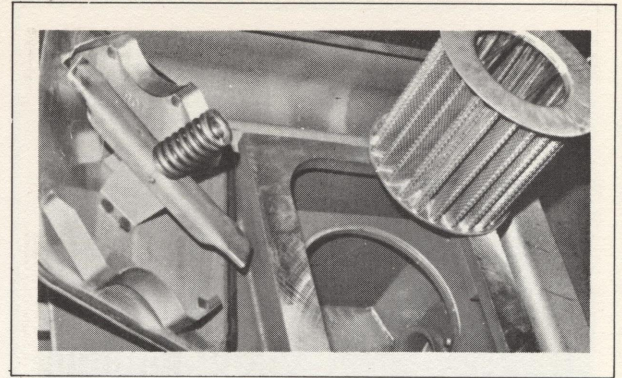


FIG. II-43. LUBE-OIL SUCTION STRAINER.

8. Opposite-side liner and rod. If the inspection is being made through a right-side door, parts of the left-side cylinder liner and rod can also be observed from this point.
9. Oil pan. Check for foreign material that may indicate a failure.

LUBE-OIL SUCTION STRAINER

The oil pan suction-strainer basket, Fig. II-43, should be removed and cleaned at each oil change or after an internal engine failure.

The purpose of the 26-mesh strainer is to keep harmful particles out of the engine lube-oil pump.

Anytime the cover is removed to service the basket, check the cover seal gasket to insure it is in good condition and properly located to prevent any possibility of sucking air when oil level is below upper surface. Otherwise, a leaking gasket can be the cause of low oil pressure (LOP) engine shutdowns.

WATER TANK

Check for evidence of leaks from the fill-cap neck and pressure-relief piping, Fig. II-44. Excessive water treatment stains might indicate a leak.

Check that the relief valve, Fig. II-44, over the cap operates properly. The purpose of the relief valve is to vent the tank pressure to prevent personal injury when the fill cap is removed.

Check that the cap can be tightened properly. A loose fill cap can cause a low water-pressure shutdown in some high-ambient temperature situations.

ENGINE AIR-FILTER SERVICE INDICATOR

Check the service indicator, Fig. II-45, to determine the condition of the paper air-filters. If the service indicator is

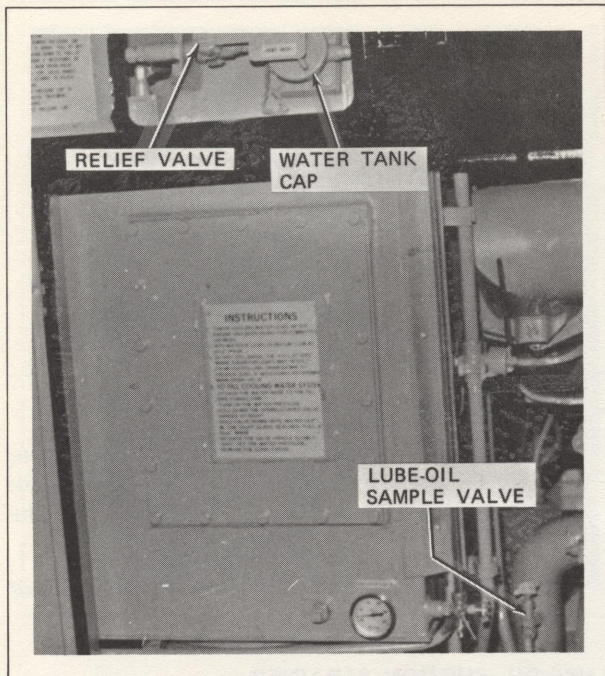


FIG. II-44. WATER TANK.

showing a red band in its "window," the filters should be changed. It is recommended that the service indicator be changed when the filters are changed. If the service indicator is not changed, it should be reset by pushing the RESET on the indicator.

The access door clamps must be tight and secured to hold the door closed. Bent doors or deteriorated seals must be repaired to prevent unfiltered air from bypassing the plastic air cleaners.

AIR-FILTER SERVICE INDICATOR

The indicator was photographed showing the red band, indicating the engine paper air-filters should be changed, Fig. II-46.

The red band becomes visible when a vacuum of 12-in. H₂O is applied to the indicator.

It is recommended that the service indicator be changed when the air filters are changed.

PLASTIC AIR-CLEANERS

Check that the engine intake plastic air-cleaners, Fig. II-47, are all in place and properly positioned. The cleaners can be viewed through the screen without opening the filter door. The right and left-side engine air intakes each require three (3) plastic air-cleaner elements.

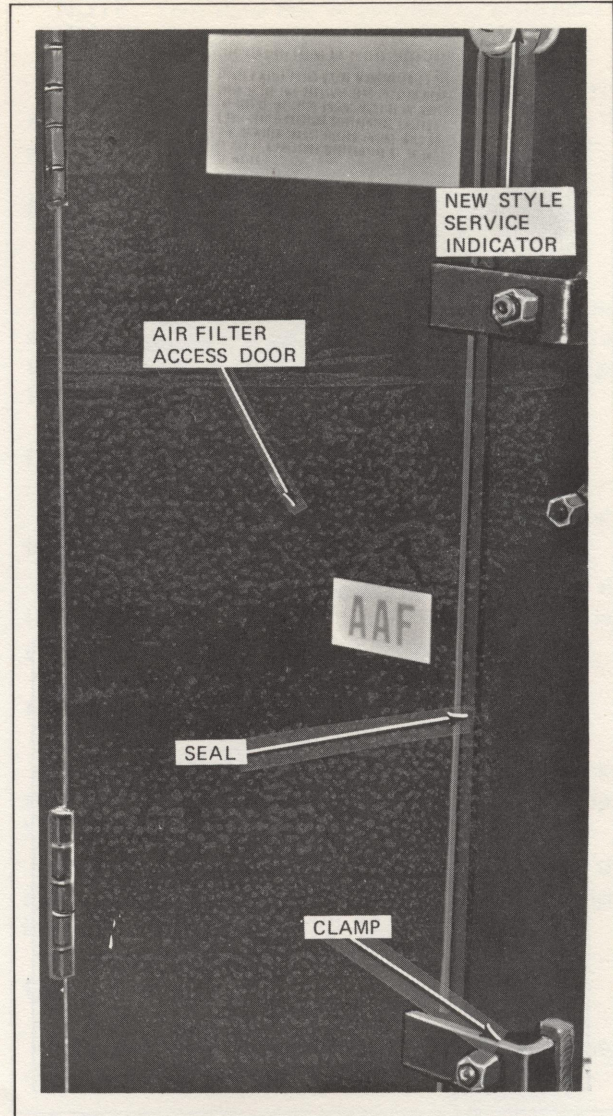


FIG. II-45. ENGINE AIR-FILTER SERVICE INDICATOR.

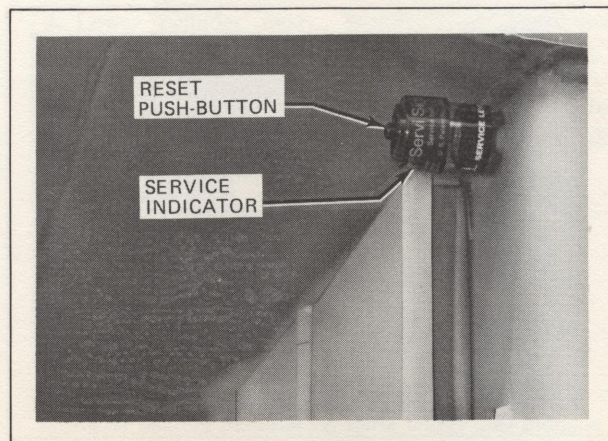


FIG. II-46. SERVICE INDICATOR.

FIG. II-44, E-24501

FIG. II-45, E-24502

FIG. II-46, E-22356A

FIG. II-47, E-24504

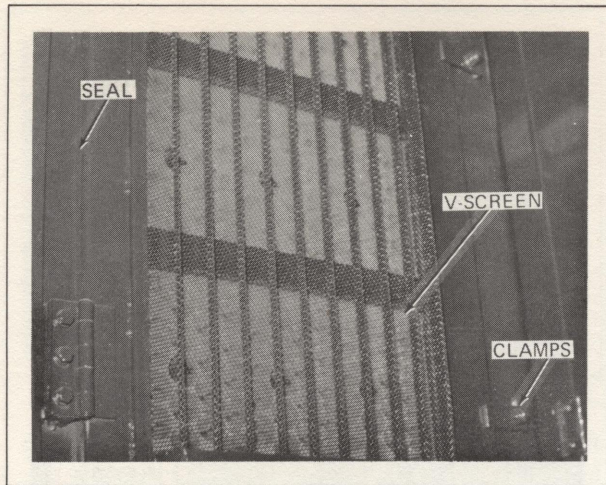


FIG. II-47. PLASTIC AIR-CLEANERS.

The door clamps over the plastic cleaners must be tight and hold the door closed securely. Bent doors or deteriorated seals must be repaired to prevent uncleaned air from bypassing the air cleaners and prematurely plugging the paper air filters.

Remove any debris that may be plugging the inlet V-screen, Fig. II-47. Debris may include paper, leaves, ice or snow.

PLASTIC AIR-CLEANERS — CORRECT INSTALLATION

When the paper air filters must be changed, check the plastic air-cleaners for proper installation, Fig. II-48. The plastic cleaner-element clamping frame has three indexing probes to insure proper installation of the plastic elements. The indexing probes will not fit into place if the air-inlet spinners in the plastic element are in the wrong position.

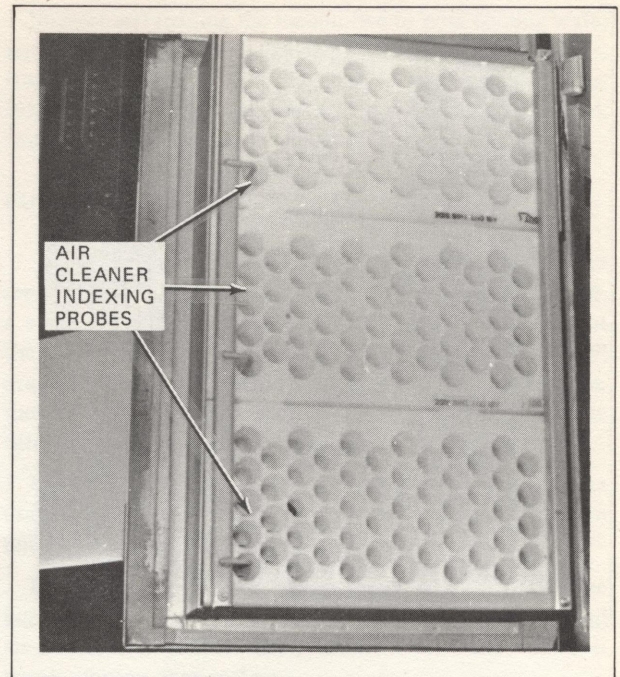
The plastic air-cleaners normally never need to be renewed or cleaned. Rain and snow should keep these cleaners dirt-free. If a 1/32-in. dirt build-up does occur in the plastic cleaner, remove the cleaner and clean out the dirt.

PLASTIC AIR-CLEANER DIRT DISCHARGE

When the paper air filters must be changed, check that the plastic air-cleaner element dirt-discharge openings match the openings in the bulkhead wall, Fig. II-49. The discharge openings are only on one end of the plastic cleaner elements.

If the plastic air-cleaner elements are installed wrong, dirt will have no way to escape and will plug the plastic air-cleaner.

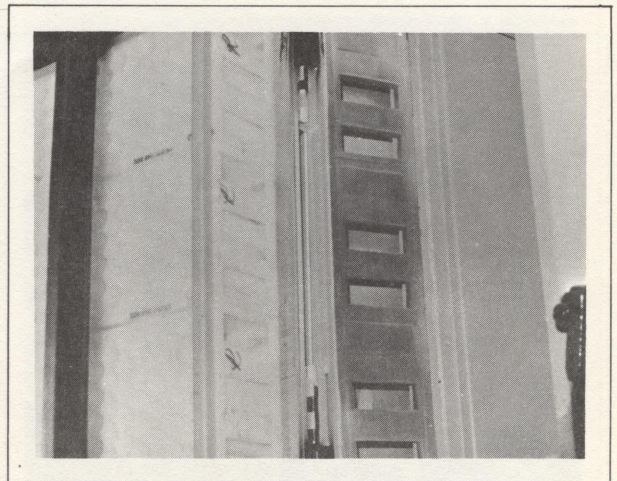
FIG. II-49, E-24506

FIG. II-48. PLASTIC AIR-CLEANERS —
CORRECT INSTALLATION.

DIRT-EDUCTOR CHECK VALVE

To test the check valve, Fig. II-50, grasp the rollpin in the shaft end and twist the shaft back and forth through a 15-degree arc. A clanging noise should be heard at each end of the arc. View is from walkway on left-side of the locomotive.

A check valve stuck in the CLOSED position will prevent proper operation of the engine plastic air-cleaner.

FIG. II-49. PLASTIC AIR-CLEANERS
DIRT DISCHARGE.

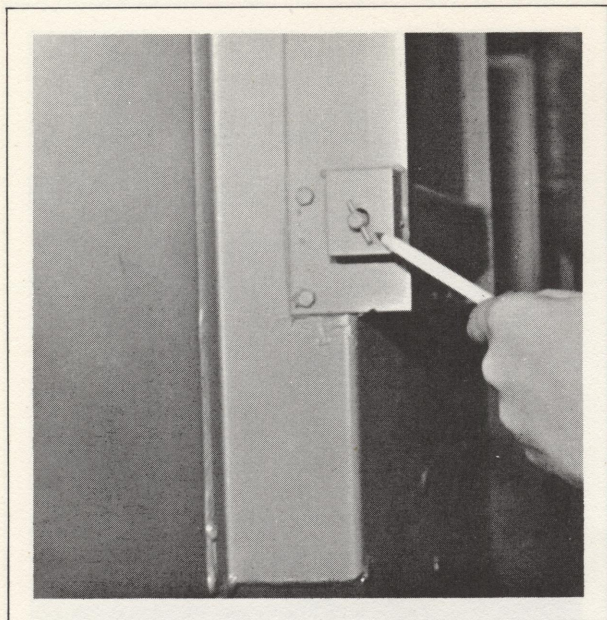


FIG. II-50. DIRT-EDUCTOR CHECK VALVE.

A check valve stuck in the OPEN position can allow exhaust gas from the engine stack to flow backward and overheat the plastic air cleaners. This will be most severe at idle and the first few throttle notches.

The check valve is located on the air compressor side of the engine hood (radiator cab wall).

TURBO-AIR ELBOWS

Combustion air leaking from turbo elbows, Fig. II-51, can cause low horsepower, excessive smoke and possible turbo damage.

Check for proper application of studs and locknuts.

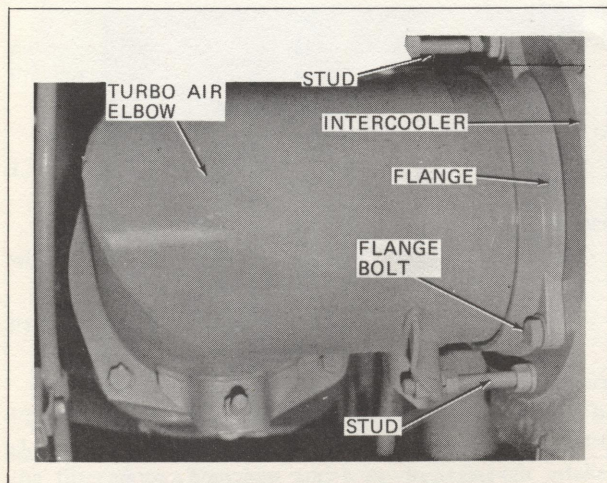


FIG. II-51. TURBO-AIR ELBOWS.



FIG. II-52. TRACTION MOTOR AIR DUCTS.

Check for proper application of flange bolts.

Check for cracks in the elbow pipe. Look for evidence of blown-out O-rings. Damaged O-rings can sometimes be observed hanging out from the flanges.

Vibration due to loose studs and flanges causes the O-rings to wear which results in air leaks.

Notch 8 NO-LOAD will produce enough turbo air so severely leaking O-rings can easily be detected by holding a hand near the escaping air. Less severe leaks can only be detected at full turbo pressure, Notch 8, FULL-LOAD.

TRACTION MOTOR AIR DUCTS

Inspect for damaged or torn flexible, rubber connections on traction motor air ducts, Fig. II-52.

Inspect the bolted connections to the traction motor. This connection should have four bolts.

A loss of ventilating air to the traction motor would affect proper cooling of the motor. Lack of proper cooling could damage the traction motor.

RADIATORS

View of the radiators, Fig. II-53, from inside the radiator cab with engine shut down.

Inspect for leaks and plugged radiators; the corner areas of the radiator must receive close inspection. Corner areas tend to become plugged before the center sections. Look for oil and/or dirt build-up.

FIG. II-50, E-24507

FIG. II-51, E-24508

FIG. II-52, E-24509

FIG. II-53, E-24510

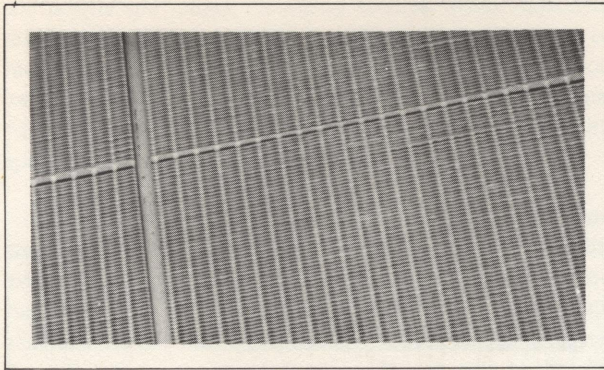


FIG. II-53. RADIATORS — CLOSE-UP VIEW.

Plugged radiators can result in inadequate cooling, hot engine alarms on the road, top liner cylinder leaks and damaged braking grids.

Pay particular attention to stains from water treatment. Remember radiators are normally filled with cooling water only when the engine temperature is above 184 F. Thus wet spots may be evident only immediately following a high-temperature shutdown.

FIG. II-54, E-24511

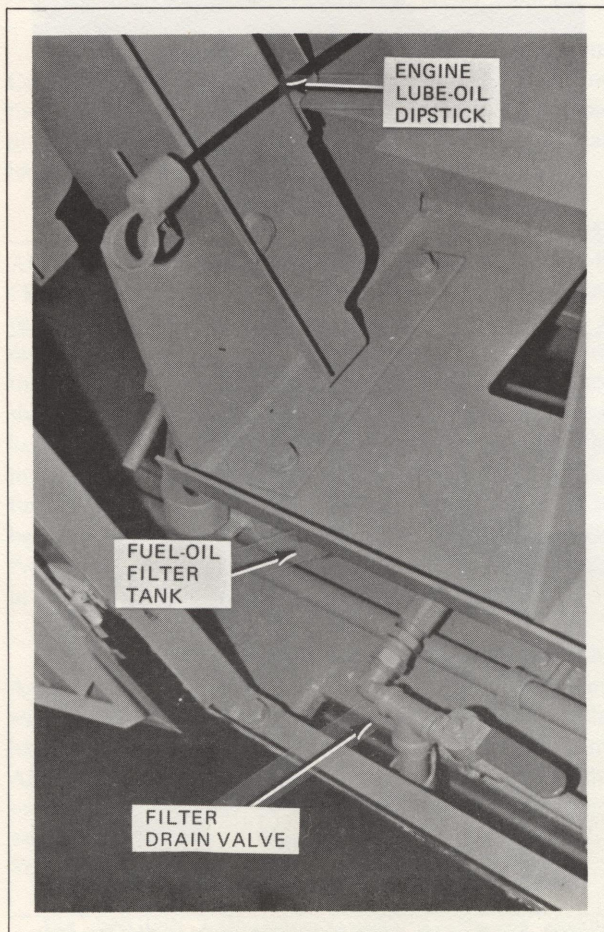


FIG. II-54. FUEL-FILTER DRAIN VALVE.

FIG. II-55, E-24512

Suggest self-loading the locomotive to raise cooling water temperature sufficiently to flood both banks of radiators (two-step control). Never pressurize the cooling water system above 20 psi since it may damage the water tank and the radiators.

FUEL-FILTER DRAIN VALVE

This valve, Fig. II-54, drains the fuel-filter tank when replacing the filter element. When the fuel filter is changed, a small amount of fuel and dirt remains at the bottom of the tank. Holding the spring-loaded drain valve open will drain the residue from the filter tank into the locomotive fuel tank. If this is not done, dirty fuel oil can get past the filter and plug the fuel injectors and score the pumps.

When changing fuel filters on locomotives without the drain valve, remove the filter-tank drain plug to drain the tank.

If fuel pressure is restricted due to air trapped in the lines, opening the spring-loaded valve may release trapped air and restore proper fuel pressure. Open valve with fuel pump running, then reclose.

Dipstick

Do not intermix dipsticks, Fig. II-54, between locomotives due to differences in calibration. This could result in crankcase overpressure (COP) trips if overfilled, and low oil pressure shutdowns if underfilled.

FUEL STRAINER

Clean the fuel strainer, Fig. II-55, each time the fuel-filter element is changed. Also remove the plug in the strainer tank and drain all residue.

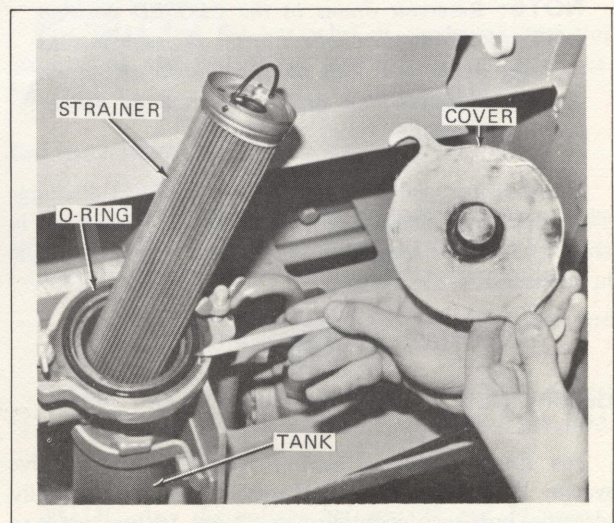


FIG. II-55. FUEL STRAINER.

Check the condition of the strainer tank O-ring before replacing the cover. Replace if necessary.

Refill the strainer tank with clean fuel or light oil to prime the system before starting the fuel pump.

ENGINE CYLINDER HATCHES

Close latches on the engine cylinder hatches, Fig. II-56. This prevents the hatches from vibrating and also allows proper latching of the side doors.

SANDING EQUIPMENT

Check the sand traps for proper operation, Fig. II-57. Most traps have quick-disconnects on outlet and sand shut-off valves to permit rodding the outlet hose if necessary.

Be sure sand is dry, otherwise it will not flow freely and will plug the traps.

Check all hoses, hose connections and hose clamps. Check that sandpipe is aligned and has proper rail clearance. The sand should be directed to the contact point of the wheel flange and the rail head.

AIR-RESERVOIR AUTOMATIC DRAIN VALVES (AIR ACTUATED)

Check that the drain valve, Fig. II-58, is in the ON position.

Operation of the valve can be checked by cycling the air-compressor governor system.

NOTE: Reservoir drains in the CLOSED position will cause moisture to collect in the reservoir instead of being discharged. This moisture in the air system can cause malfunction or deterioration of the air brake equipment.

Elbow is included in discharge port to direct discharge away from track ballast; in case locomotive is standing in same location for sometime, otherwise it may blast a hole in the ballast.

ENGINE SYSTEMS MONITOR

DESCRIPTION

The Engine Systems Monitor (ESM) is a protective system that electrically, mechanically and automatically identifies improper locomotive conditions. Its function is to provide over-the-road reliability, avoid unnecessary

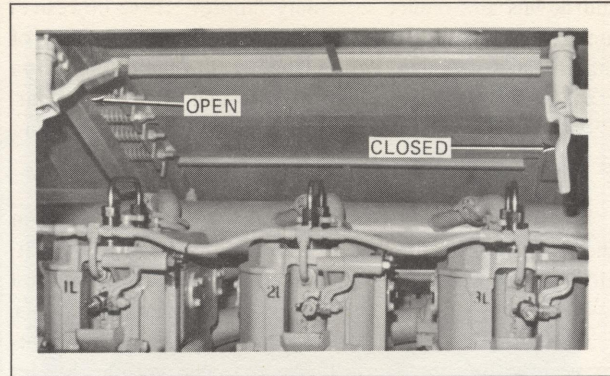


FIG. II-56. ENGINE CYLINDER HATCHES.

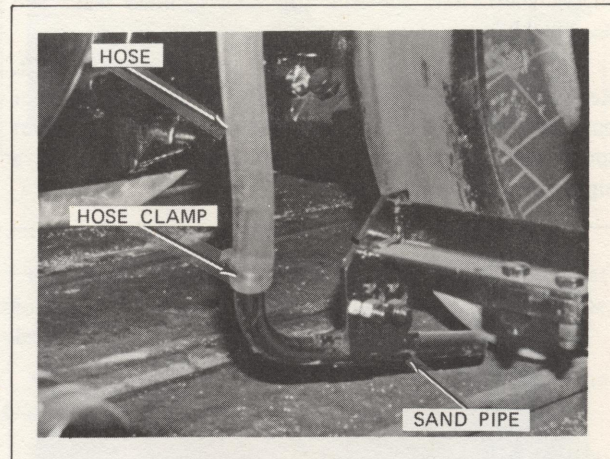


FIG. II-57. SANDING EQUIPMENT.

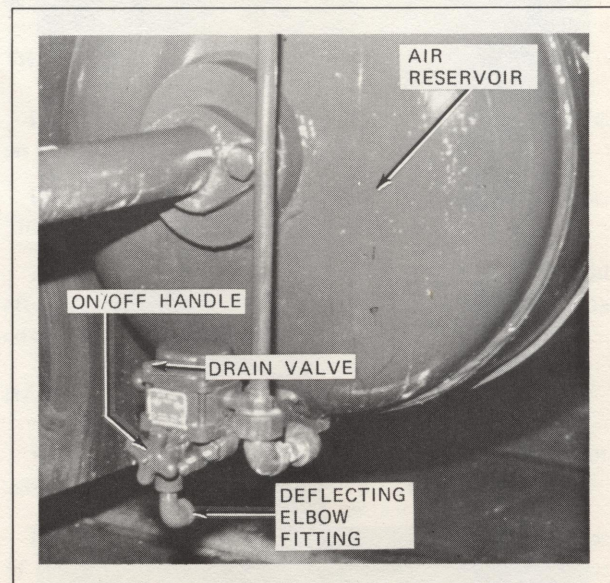


FIG. II-58. AIR-RESERVOIR AUTOMATIC DRAIN VALVES (AIR ACTUATED).

FIG. II-56, E-24513

FIG. II-57, E-24514

FIG. II-58, E-24515

shutdowns and reduce secondary failures. These objectives are accomplished by indicating when and what kind of maintenance work is required before the faulty condition causes a shutdown or road failure. Under most conditions, ESM will keep the diesel engine running although load and speed may be reduced to match the unit's capabilities.

When a problem occurs, malfunction indicating lights on the Engine Control Panel in the operator's cab will be lit, either singly or in combination, to advise the crew and maintenance personnel that a problem has developed. Also, malfunction indicating lights on an Annunciator Panel located within the control compartment will be lit. By observing the indicating lights, comparing their pattern shown on the ESM Diagnostic Chart, Fig. II-59, and checking the most probable cause, maintenance personnel can quickly analyze and correct the problem.

ESM DIAGNOSTIC CHART

The ESM Diagnostic Chart, Fig. II-59, presents a listing of indicating lights and system conditions including the most probable cause(s) of the problem.

When one or more ESM indicating lights on the Engine Control (EC) Panel are lit, one or more indicating lights on the Annunciator Panel also will be lit. By comparing those illuminated with the chart, maintenance personnel can identify which line of the chart applies to the problem.

For example: If the NO BATTERY CHARGE, ANNUNCIATOR PANEL and CRANKCASE OVER-PRESSURE lights are lit, Line No. 1 applies. Note that the EC PANEL LIGHTS column for Line No. 1 is divided into two sections. The top section lists the lights that are lit for a specific problem and alerts the train crew that some action may have to be taken. The bottom section lists the ANNUNCIATOR PANEL light which alerts the maintenance personnel that a problem had occurred and further investigation is warranted. In this case, the action to be taken by the train crew is to reset the Crankcase Over Pressure (COP) switch (see ENGINE CONDITION column) in accordance with recommended railroad procedures.

The CRANKCASE OVER PRESSURE light on the Annunciator Panel (see ANNUNCIATOR PANEL column) will remain lit after COP is reset to indicate that the locomotive experienced a crankcase overpressure problem. After the maintenance personnel has resolved the overpressure problem, the light on the Annunciator Panel can be turned-off by lifting-up the spring-loaded, RESET Toggle switch on the Annunciator Panel.

The ENGINE CONDITION column lists the various possible engine modes such as shutdown, idling or running.

The MOST PROBABLE CAUSE column lists the causes in descending order of probability. Thus, too high oil level in the crankcase would be considered the most probable cause; a plugged crankcase breather screen would be the least likely cause.

It should be noted that order of severity generally increases from Line No. 1 through Line No. 10. If an indication on one of the upper lines is ignored, expect progression to one of the lower.

The ESM Diagnostic Chart also has a column titled HOLD RELAY. This column lists the Engine Temperature Holding Relay (ETHR) and the Governor Shut Down Holding Relay (GSDHR). The ETHR relay will pick-up if the engine experiences an engine overtemperature condition. This condition is usually caused by high lube oil temperature, or low water pressure which causes the water temperature to increase above normal operating temperature. The GSDHR relay will pick-up if the engine experiences a very low oil pressure and/or very low water pressure condition, and the governor will then shut down the engine.

FUNCTIONAL CHECKS

DESCRIPTION

A functional check of the locomotive can be performed using the TM14 Test Kit.

The TM14 Test Kit, Fig. II-60, is a portable, externally-powered, static-component device which is used to check and calibrate wheelslip/slide detection, speedometer, transition and speed-sensing systems on locomotives.

The TM14 Test Kit has a list of condensed operating instructions attached to its cover for quick reference, Fig. II-61.

CALIBRATION

The TM14 Test Kit calibration procedure consists of two self-checks. There are no adjustments to make. Perform the following self-check steps each time the test kit is used.

1. See Fig. II-62 for Range/Function switch location and move switch to CHECK position.
2. Connect a 24 to 74 vdc source to d-c input on test kit. A nonremovable cord with clip leads is provided, Fig. II-60.

NOTE: Any d-c voltage between 24 and 74 volts will operate this test kit.

ENGINE SYSTEMS MONITOR DIAGNOSTIC CHART					
LINE NO.	EC PANEL LIGHTS (Throttle at IDLE)	CONTROL COMP. LIGHTS		ENGINE CONDITION (Unless Manually Shut Down)	CHECK EQUIPMENT LISTED FOR MOST PROBABLE CAUSE
		ANNUNC. PANEL	HOLD REL.		
1	NO BATT. CHARGE ANNUNC. PANEL CR'CASE OVER PR.	 CRANKCASE OVERPRESS.	 	SHUTDOWN: will not crank until COP is reset. Indicates engine had excess crankcase pressure.	Too high oil level in crankcase, piston blow-by, plugged crankcase breather screen.
	ANNUNC. PANEL			RUNNING: indicates COP switch has tripped and been reset.	
2	ANNUNC. PANEL ENGINE AIR FILTER	 ENGINE PAPER FILTER	 	IDLING: will not load. Indicates engine paper air filters excessively dirty.	Dirty engine paper air filters, blockage in primary air cleaners, debris obstructing engine air intake screens.
	ANNUNC. PANEL			RUNNING: may take full load. Indicates Engine Paper Filter Switch and Relay has tripped and been reset.	
3	ANNUNC. PANEL	 LOW OIL PRESS.	 	RUNNING: may take full load. Indicates engine experienced low oil pressure.	Low oil level, dirty oil filter, open filter tank drain-back valve (C), dirty lube oil cooler — oil side, dirt in crankcase oil strainer, faulty lube oil relief valve, dirty fuel filter or strainer, failed (slipping) bonded pump drive, electrical bogging or overloading governor.
4	ANNUNC. PANEL	 LOW OIL PRESS.  LUBE OIL TEMP.	 	RUNNING: may take full load. Indicates engine experienced low oil pressure and high oil temperature.	Very dirty, almost plugged lube oil cooler — oil side. Also check all equipment listed on Lines 3 and 9. A more severe condition likely exists.
5	NO BATT. CHARGE ANNUNC. PANEL GOV. SHUTDOWN	 LOW OIL PRESS.	 	SHUTDOWN: will not crank until reset. Indicates engine experienced very low oil pressure.	All equipment listed on Line 3. A more severe condition likely exists. Also investigate engine for failed lube oil pump.
6	ANNUNC. PANEL	 LOW WATER PRESS.	 	RUNNING: may take full load. Indicates engine experienced low water pressure.	Low water level, cooling system not pressurized, dirty lube oil cooler — water side, water tank or lube oil cooler inlet screen plugged, dirty fuel filter or strainer, failed (slipping) bonded pump drive, governor.
7	ANNUNC. PANEL	 LOW WATER PRESS.  LUBE OIL TEMP.	 	RUNNING: may take full load. Indicates engine experienced low water pressure and high oil temperature.	Very dirty, almost plugged lube oil cooler — water side. Also check all equipment listed on Line 6 and 9. A more severe condition likely exists.
8	NO BATT. CHARGE ANNUNC. PANEL GOV. SHUTDOWN	 LOW WATER PRESS.	 	SHUTDOWN: will not crank until reset. Indicates engine experienced very low water pressure.	All equipment listed on Line 6. A more severe condition likely exists. Also investigate engine for failed water pump.
9	ANNUNC. PANEL	 LUBE OIL TEMP.	 	RUNNING: may take full load. Indicates engine experienced high oil temperature.	Dirty radiators, plugged air inlet screens, excessive braking current, faulty control of water temperature, dirty lube oil cooler — either side, excess horsepower output. (May also be caused by very high ambient temperature or by tunnel operation.)
10	ENGINE OVERTEMP. ANNUNC. PANEL		 	IDLING: will not load. Indicates engine experienced very high water temperature.	Severe cooling system-related problem. If the system checks OK, test LOT switch. It may not be indicating that a high lube oil temperature has occurred. If LOT switch is found faulty, proceed to Line 11.
11	ENGINE OVERTEMP. ANNUNC. PANEL	 LUBE OIL TEMP.	 	IDLING: will not load. Indicates engine experienced very high oil or oil and water temperature.	All equipment listed on Line 9. A more severe condition likely exists. Also inspect for failed fan drive.
12	ENGINE OVERTEMP. ANNUNC. PANEL	 LOW WATER PRESS.	 	IDLING: will not load. Indicates engine experienced low water pressure and very high water temperature.	Low water level.
13	OVERLOAD RELAY TRIPPED ANNUNC. PANEL	 GENERATOR OVERLOAD	 	IDLING: will not load. Indicates main alternator experienced a surge of current. Reset GOLR to make unit operable.	Traction motors for signs of flashover; motors for shorted fields, busbars, or leads; bus bars and cables at main alternator and rectifier panels for loose connections; current limit adjustment in excitation panel; failure of ACCR; single-phasing of alternator; GOLR for defects; alternator field connections and busbars for a short circuit.
	ANNUNC. PANEL			RUNNING: may take full load. Indicates GOLR has tripped and been reset.	
14	GROUND RELAY TRIPPED ANNUNC. PANEL	 GROUND RELAY	 	IDLING: will not load. Indicates power circuits have experienced a ground.	Electrical power equipment for evidence of a flashover, intermittent ground, or continuing ground.
	ANNUNC. PANEL			RUNNING: may take full load. Indicates GR has tripped and been reset.	
15	ANNUNC. PANEL HOT DIODES	 HOT DIODES	 	IDLING: will not load. Indicates one or more rectifier panels have experienced excessive temperature.	Main alternator for loose or missing covers, accumulation of debris on blower intake screens, inoperative blower, failed diodes in rectifier panels, single-phased alternator.
	ANNUNC. PANEL			RUNNING: may take full load. Indicates one or more hot diode detectors have tripped and relay has been reset.	
16	REDUCED EXCIT. ANNUNC. PANEL	 REDUCED EXCITATION	 	RUNNING: will not take full load. Indicates problem in Excitation Panel causing operation in Reduced Excitation mode.	Excitation panel for proper cards in correct locations. Each card for dirty, bent, or broken contact pins. Faulty card. Allied circuits for loose or broken wires or components, including feedback connections from rectifier panels and ACCR to excitation panel. Make sure alternator is not single-phased. Make sure governor plug connection and wiring is correct.
	ANNUNC. PANEL			RUNNING: will take full load. Indicates some period of operation in Reduced Excitation mode, and switch on MD card has been reset.	

FIG. II-59. ENGINE SYSTEMS MONITOR DIAGNOSTIC CHART.

FIG. II-60, E-23515

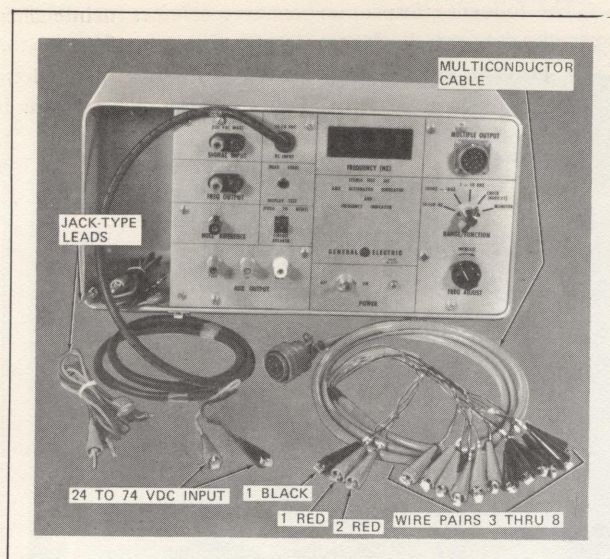


FIG. II-60. TM14 TEST KIT.

NOTE: Observe polarity. Red is positive; black is negative. Reverse polarity will trip the test kit Circuit Breaker. The Reset button pops out in the TRIPPED position, Fig. II-62.

3. Move the test kit Power switch to ON. The red indicating light next to the Power switch will indicate power being supplied to the test kit.
4. Push the Display Test button and hold. Read 8888 on the Frequency (Hz) display. Release button.

NOTE: Failure to read 8888 may indicate a failed display digit.

5. With the Range/Function switch still in the CHECK position, read 4000 ± 1 on the Frequency (Hz) display.

NOTE: Failure to read 4000 ± 1 may indicate a malfunction of the test kit internal counter circuitry.

6. Self-check completed. Place test kit Power switch in the OFF position. If the self-checks given in Steps 4 and 5 do not produce the required results, obtain repair service for this test kit. Do not attempt to use this test kit if it is not operating properly. Incorrect values and settings may result.

CAUTION: The TM14 Test Kit is designed as a multi-purpose test instrument which can produce a wide range of frequencies. Do not use frequencies higher than those needed to test a specific apparatus. Excessive output frequency from the test kit may damage some equipment. When operating the Range/Function switch, set the Freq. Adjust knob to the minimum (CCW) position and turn the test kit Power switch off. This will reduce the possibility of producing excessive output frequency during range changes.

FIG. II-61, E-23516

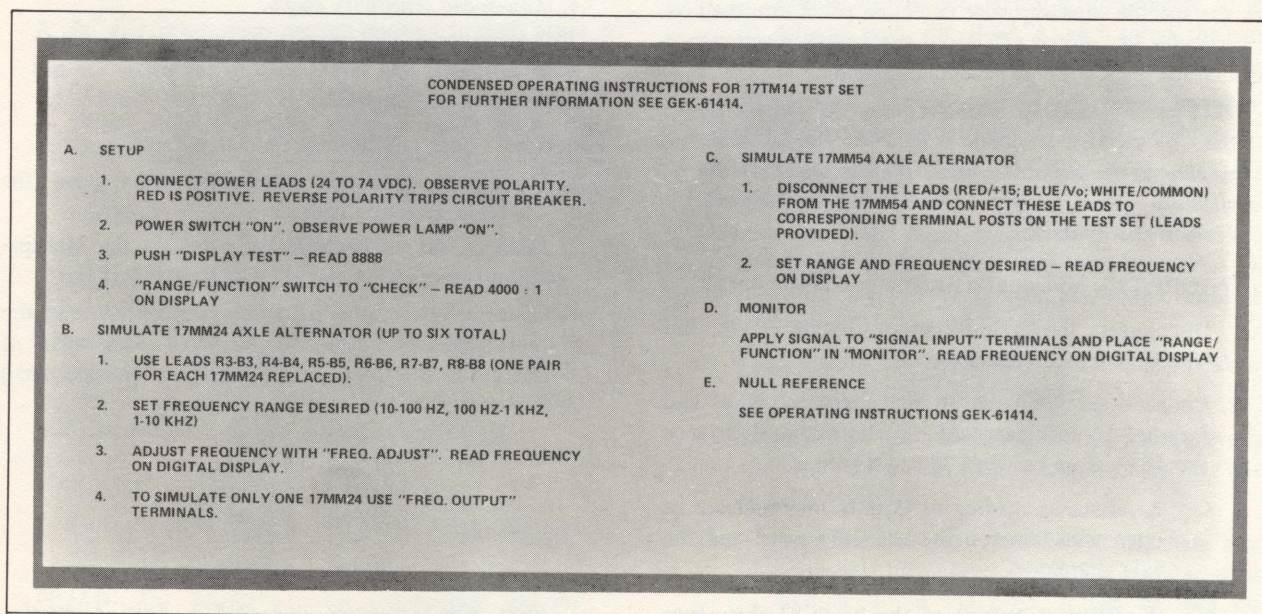


FIG. II-61. CONDENSED OPERATING INSTRUCTIONS (ATTACHED TO INSIDE COVER).

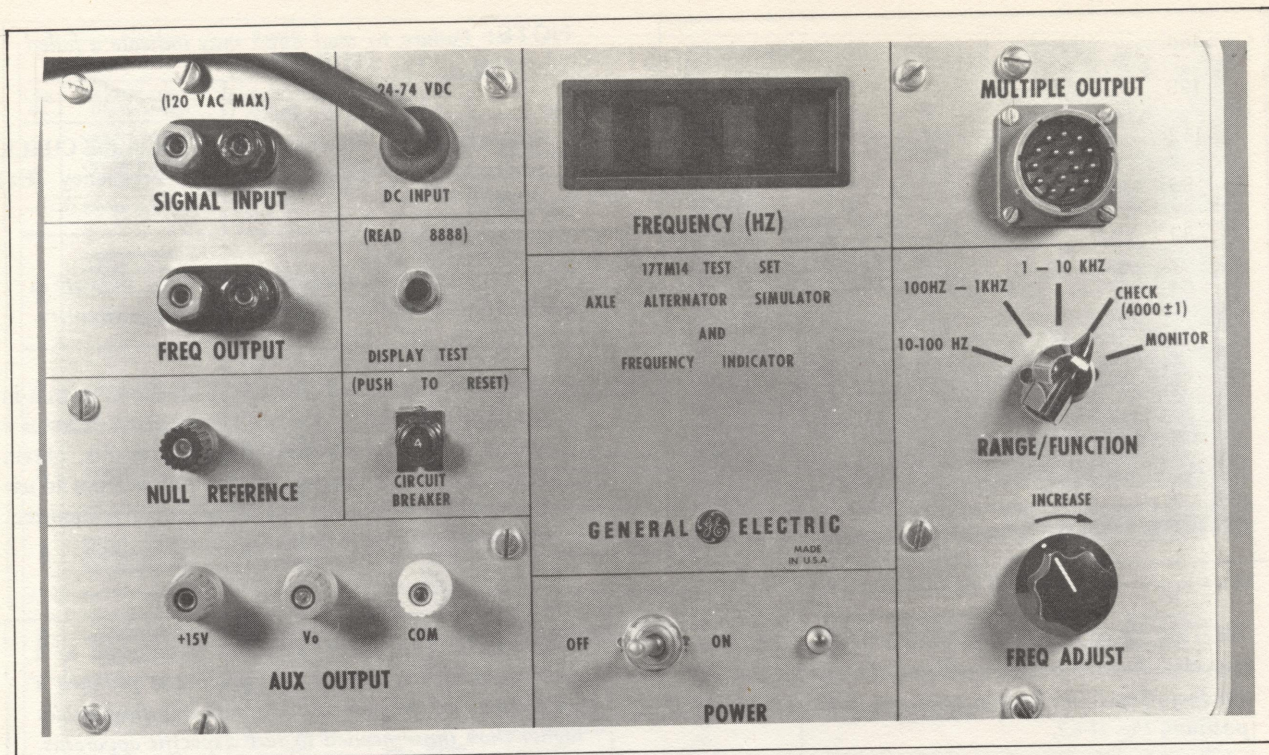


FIG. II-62. TM14 TEST KIT FRONT PANEL.

WHEELSLIP DETECTION PANEL (WITH AXLE ALTERNATORS)

Wheelslip Trouble-Shooting

The following four subsections, dealing with the panel functional check, axle circuits balance adjustment and high and low-speed sensitivity checks, have been designed to be used in conjunction with the trouble-shooting procedures for the specific wheelslip/slide detection panel furnished on a particular locomotive. Refer to the overall maintenance manual for the applicable panel publication.

NOTE: A wheelslip problem may be caused by loose or broken connections between the wheelslip panel and the axle alternators. Before checking the wheelslip panel, verify connections to the axle alternators are intact.

To verify Type MM24 Axle Alternator connections:

1. Disconnect the axle alternator wires from the wheelslip detection panel.
2. Connect an ohmmeter to the alternator wires and measure the resistance of the alternator. Resistance should measure between 73 and 83 ohms.
 - a. A resistance reading of infinity may indicate an open wire between the wheelslip panel and the axle alternator.
 - b. A resistance outside of the 73 to 83-ohm range may indicate a defective axle alternator.

NOTE: When using the TM14 Test Kit to calibrate wheelslip detection panel, it is recommended the following four checks be performed in the order they are given:

1. Functional check of wheelslip detection panel
2. Balance adjustment of axle circuits
3. High-speed sensitivity check
4. Low-speed sensitivity check.

This sequence should provide the quickest solution to most problems that might exist in the panel. Do not deviate from this sequence.

Functional Check of Wheelslip Detection Panel

1. Disconnect the axle alternator wires from the wheelslip detection panel.
2. Connect the multiconductor cable to the Multiple Output plug on the test kit, Fig. II-60.
3. Connect one of the following pairs of wires of the multiconductor cable in place of each pair of alternator wires removed. (Polarity is unimportant.)

The wire pairs are:

- 3 Red - 3 Black
- 4 Red - 4 Black
- 5 Red - 5 Black
- 6 Red - 6 Black
- 7 Red - 7 Black
- 8 Red - 8 Black.

Each pair simulates one MM24 Axle Alternator output.

FIG. II-63, E-12350B

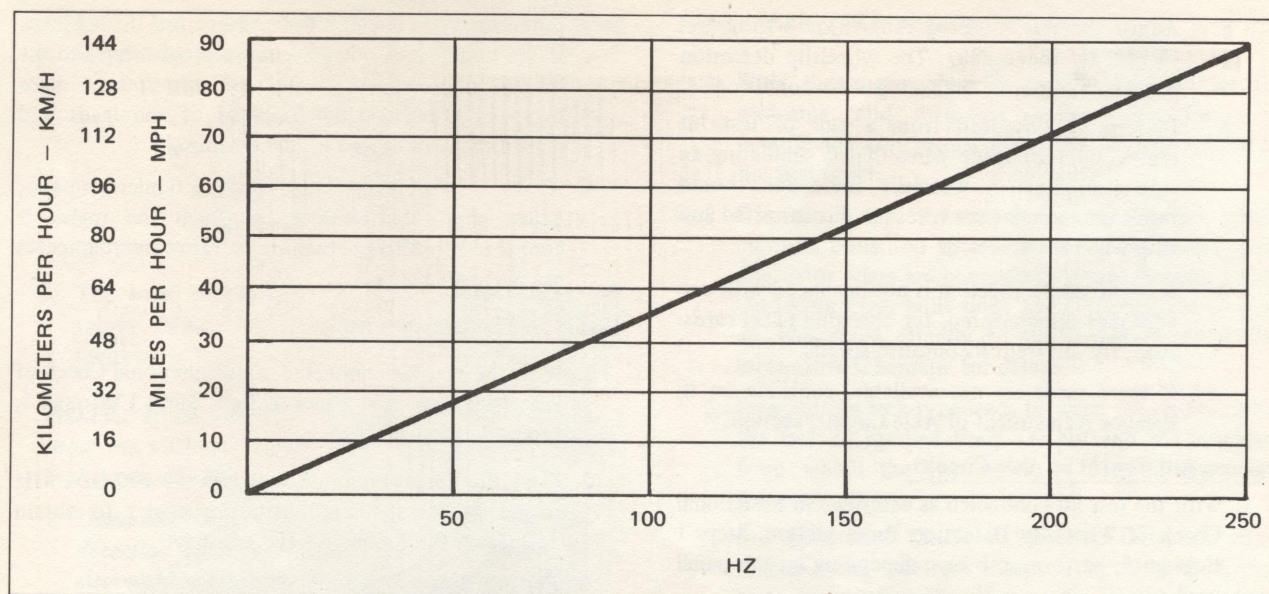


FIG. II-63. MPH VS. FREQUENCY FOR 17MM24 AXLE ALTERNATOR (40-IN. WHEELS).

NOTE: Multiconductor cable clip leads 1 Black, 1 Red and 2 Red are not being used in this step of the test. Secure them out of the way where they will not be in contact with other terminals or parts of the locomotive. Do not short unused pairs together since possible internal damage may result.

On a four-axle locomotive, in addition to clip leads 1 Black, 1 Red and 2 Red, two additional pairs will not be used. Also secure these leads out of the way. It does not matter which clip lead pairs are not used. For convenience, do not use 7 Red – 7 Black and 8 Red – 8 Black.

4. Be sure other wires are not shorted to each other or to locomotive.
5. Connect the d-c input cord on the test kit to a 24 to 74 vdc source. Observe polarity; red positive, black negative.
6. Place Range/Function switch in the desired range, Fig. II-63.

CAUTION: Do not exceed 400 Hz when testing wheelslip, transition or speedometer systems. Excessive output frequency may damage these systems. When operating the Range/Function switch, set the Freq. Adjust knob to the minimum (CCW) position and turn the test kit Power switch off.

7. Place the test kit Power switch to ON.
8. Turn the Freq. Adjust rheostat to obtain Hz desired, Fig. II-63.

NOTE: The wheelslip relay will operate and the light or buzzer will indicate a slip when Freq. Adjust

rheostat is turned rapidly (if anticipation capacitor is used in the wheelslip panel). The slip indication should stop when the rheostat motion is stopped. This indicates the anticipation capacitor is working satisfactorily. If the signal does not stop, consult the trouble-shooting guide for the appropriate panel.

If the wheelslip relay does not operate during a rapid twist of the frequency-control rheostat, the anticipation capacitor may be open, the transistor may be open, or the system wiring may be open.

9. Observe the panel operation at various simulated locomotive speeds. Set the test kit to simulate 10, 20, 30, 40, etc. mph, Fig. II-63. At each speed, the panel should not give any wheelslip indication.

NOTE: Some panels contain overspeed circuitry that will give a wheelslip indication at 70 or 80 mph.

If the panel does cause a wheelslip relay pick-up or other related operation, obtain a new set of panel cards and insert them, if spare cards are available. If these new cards correct the wheelslip situation, substitute the old cards one at a time, until the defective card is located.

If spare cards are not available, continue to Balance Adjustment of Axle Circuits section.

10. Observe that the wheelslip detection panel energizes the locomotive WSR Relay when one axle alternator signal is removed.
 - a. Adjust the test kit frequency to simulate some reasonable locomotive speed. For example, select 40 mph. From Fig. II-63, it can be seen that 40 mph would produce a 115-Hz frequency.

- b. Adjust the test kit Freq. Adjust knob to obtain 115 Hz on the display. The wheelslip detection panel should not be indicating a slip condition.
 - c. Disconnect one lead from a pair of test kit multiconductor cable wires that is simulating an axle alternator. A wheelslip indication should result the moment the wires are disconnected and stop when reconnected.
 - d. If a wheelslip indication is not produced with one wire pair disconnected, try changing panel cards. Also, try different locomotive speeds.
- If spare cards are not available, continue on to Balance Adjustment of Axle Circuits section.

Balance Adjustment of Axle Circuits

1. With the test kit connected as described in Functional Check of Wheelslip Detection Panel section, Steps 1 through 5, perform a, b or c depending on the panel used.
 - a. On the FM190 panel (four-axle system):
 - Connect No. 1 Black lead to TB1H.
 - Connect No. 2 Red lead to TB2J.
 - Connect No. 1 Red lead to TB2K.
 - b. On the FM190 panel (six-axle system):
 - Connect No. 1 Black lead to TB1F.
 - Connect No. 2 Red lead to TB1E.
 - Connect No. 1 Red lead to TB1D.
 - c. On the FL7 and FL8 panels (four-six axle systems), remove the card on which the balance is to be checked, insert the card extender, and plug the card into it:
 - Connect No. 1 Black lead to card terminal Pin A.
 - Connect No. 2 Red lead to card terminal Pin H.
 - Connect No. 1 Red lead to card terminal Pin G.
2. Set the test kit Range/Function switch to 100-1 kHz. Adjust the Freq. Adjust rheostat to read at least 150 Hz on the test kit frequency display.

CAUTION: Do not exceed 400 Hz when checking wheelslip, transition or speedometer systems. Excessive output frequency may damage these systems. When operating the Range/Function switch, set the Freq. Adjust knob to the minimum (CCW) position and turn the test kit Power switch OFF.

3. Using a multimeter (on the highest milliamp scale available), clip the positive lead of the meter to the test kit terminal marked Null Reference. Clip the negative lead to the center tap of the balance

potentiometers one at a time, and record the readings. If the meter does not read, move progressively to the lowest microampere scale. (If the meter reads backwards, change the polarity of the leads and record the reading as a negative reading.)

4. If the meter reads more than ± 6 microamperes, adjust the potentiometer to which the meter is connected to zero microamperes. (Zero microamperes is a perfect balance.)

High-Speed Sensitivity Check

1. With the test kit connected as in Functional Check of Wheelslip Detection Panel section, Steps 1 through 5, proceed as follows:
2. Place the Range/Function switch in the 100 Hz-1 kHz range. Adjust the Freq. Adjust rheostat to obtain 150 Hz on the Frequency (Hz) display.
3. Perform a or b depending on panel used.
 - a. On the FM190 panel: Using a multimeter, measure the voltage between the brush arms of P7 and P8 (the two rheostats at the top of the 426C921 and 41C650359 cards). Voltage should be 0.75 v. Adjust P7 rheostats (furthest from the terminal board) if necessary.
 - b. On the FL7 and FL8 panels: Using a multimeter, measure the voltage from Pin E (+) to H (-) on the 182 card. Voltage should be 0.41 v. Adjust the R9 rheostat (rheostat has center tap shorted to one outside terminal) if necessary.

Low-Speed Sensitivity Check

1. Connect only one pair of wires from the multiconductor cable to wheelslip-detection panel terminals in place of any one pair of alternator wires. All other wires from the Multiple Output cable should be disconnected.
2. Proceed as in Functional Check of Wheelslip Detection Panel section, Steps 4 and 5.
3. Place the test kit Range/Function switch in the 10-100 Hz position.
4. Set the Freq. Adjust rheostat to its extreme counterclockwise position. The meter should indicate 10 Hz or less.
5. Turn the Freq. Adjust rheostat to increase the frequency output. The wheelslip relay should operate at 14 Hz. On the FM190 panel, adjust P8 rheostat (on the 426C921 and 41C650359 card, at top, closest to the terminal board strip) if necessary. If this adjustment is changed, the high-speed sensitivity must be checked. See High-Speed Sensitivity Check section. On the FL7 and FL8 panels, no adjustment is provided.

For a locomotive with 40-in. wheels, the following relationship exists:

- 11 Hz equals 4 mph.
- 14 Hz equals 5 mph.
- 17 Hz equals 6 mph.
- 20 Hz equals 7 mph.
- 22 Hz equals 8 mph.

The basic relationship is 2.8 Hz equals 1 mph. All values listed are rounded to the nearest whole number.

NOTE: *If all four of the previous checks do not show the cause of trouble, the trouble is most likely in the axle alternators.*

1. Disconnect the alternator wires from the wheelslip detection panel. Connect an ohmmeter to alternator wires, and measure the resistance of the alternator. Resistance should measure between 73 and 83 ohms.
2. If resistance is within limits specified in Step 1, remove axle alternator cover and check for a loose rotor, broken or loose parts or other mechanical damage.

SPEEDOMETER SETTING

1. Disconnect the one set of axle alternator wires (which controls speedometer readings) from the axle circuit on wheelslip detection panel, or if wheelslip detection is not used, from speedometer panel. See locomotive schematic for exact circuit.
2. Connect jack-type leads between the two plugs on test kit marked Freq. Output and terminals from which two wires, in Step 1, have been removed.
3. See Functional Check of Wheelslip Detection Panel section, and perform Steps 5, 6, 7 and 8.

CAUTION: *Do not exceed 400 Hz when checking wheelslip, transition or speedometer systems. Excessive output frequency may damage these systems. When operating the Range/Function switch, set the Freq. Adjust knob to the minimum (CCW) position and turn the test kit Power switch OFF.*

4. If readings on speedometer and test kit do not correspond with those shown in Fig. II-63, adjust the calibration potentiometer (on FM192 speedometer panel) to obtain desired proportion.

AUTOMATIC TRANSITION SETTING

1. With the engine shut down, the controls set for motoring, and sufficient control air pressure to operate the contactors, move the Throttle handle to the first notch.
2. Disconnect the one set of alternator wires which controls transition speeds. On some locomotives the alternator wires are connected to the wheelslip panel. On locomotives built since 1977, the alternator wires are connected directly to the transition panel. See locomotive schematic for details.
3. Connect the jack-type leads between the two plugs on the test kit marked Freq. Output and the terminals from which the two wires, in Step 2, have been removed.
4. See Functional Check of Wheelslip Detection Panel section, and perform Steps 5, 6, 7 and 8. See locomotive schematic diagram for specific transition settings.

NOTE: *Many locomotives use a transition time-delay circuit. This causes the traction motor power contactors to be energized at some preset amount of time (seconds) LATER than the transition panel is actuated. Refer to the locomotive schematic to determine exact transition time delay action.*

CHECK 17MM24 AXLE ALTERNATOR OUTPUT WITH LOCOMOTIVE MOVING

NOTE: *Remember to calibrate this test kit before using. See Calibration section.*

1. Connect test kit Signal Input terminals in parallel with the axle alternator output (jack-type leads provided).
2. Connect d-c input cord on test kit to a 24 to 74 vdc source. Observe polarity; red positive, black negative.
3. Place the test kit Power switch to ON.
4. Place Range/Function switch in the MONITOR position.
5. The test kit frequency display will indicate Hz when the alternator rotates. Hz are proportional to miles per hour, as shown in Fig. II-63.

TYPE MM54 SPEED SENSOR SIMULATION AND MONITOR

The TM14 Test Kit will simulate the output of one 17MM54 Speed Sensor. Refer to the overall maintenance manual and the locomotive schematic.

1. Connect the test kit as described in Functional Check of Wheelslip Detection Panel section, Steps 4 thru 6.
2. Disconnect the leads connecting the 17MM54 Speed Sensor to its control panel at the control panel. The control panel will usually be located in the control compartment of the locomotive.
3. Using jack-type leads provided, connect the TM14 Test Kit Aux. Output terminals (+15, Vo, Com) to corresponding terminals of the control panel from which the speed sensor leads were removed.

NOTE: Early versions of the MM54 Speed Sensor had the speed sensor terminals labeled 1, 2 and 3. These terminals are as listed below:

Terminal 1 – Common
Terminal 2 – Vo
Terminal 3 – +15 vdc.

Newer versions use color-coded terminals.

White Terminal – Common
Blue Terminal – Vo
Red Terminal – +15 vdc.

4. Set the test kit Range/Function switch to the frequency range desired. See Fig. II-64.
5. Adjust the Freq. Adjust knob to obtain frequency desired. See Fig. II-64. Read frequency on the Frequency (Hz) display.

NOTE: The 17MM54 Speed Sensor generates a signal that gives 50 Hz/mph.

To check the MM54 Speed Sensor with locomotive moving:

1. See Check 17MM24 Axle Alternator With Locomotive Moving section. Perform Steps 2 thru 4.
2. Connect test kit Signal Input terminals in parallel with the MM54 Speed Sensor output (Vo, Common).
3. The test kit Frequency (Hz) display will indicate Hz when the speed sensor rotates.

NOTE: Hz are proportional to speed, as shown in Fig. II-64. The speed sensor generates a signal that gives 50 Hz/mph.

TYPE MM102 SPEED SENSOR SIMULATION AND MONITOR

NOTE: This TM14 Test Kit will simulate the output of the 17MM102 motor Speed Sensor. To simulate the 17MM102 output, use the Aux. Output (+15 v, Vo, Com) terminals on the test kit. The general procedure is similar to the 17MM54 Speed Sensor. For exact details and frequency settings, consult the maintenance instruction covering the system using the 17MM102 Motor Speed Sensor.

The MM102 Motor Speed Sensor can be monitored by connecting the sensor output in parallel with the test kit signal input. Also perform Steps 2 thru 4 given in Check 17MM24 Axle Alternator Output with Locomotive Moving section.

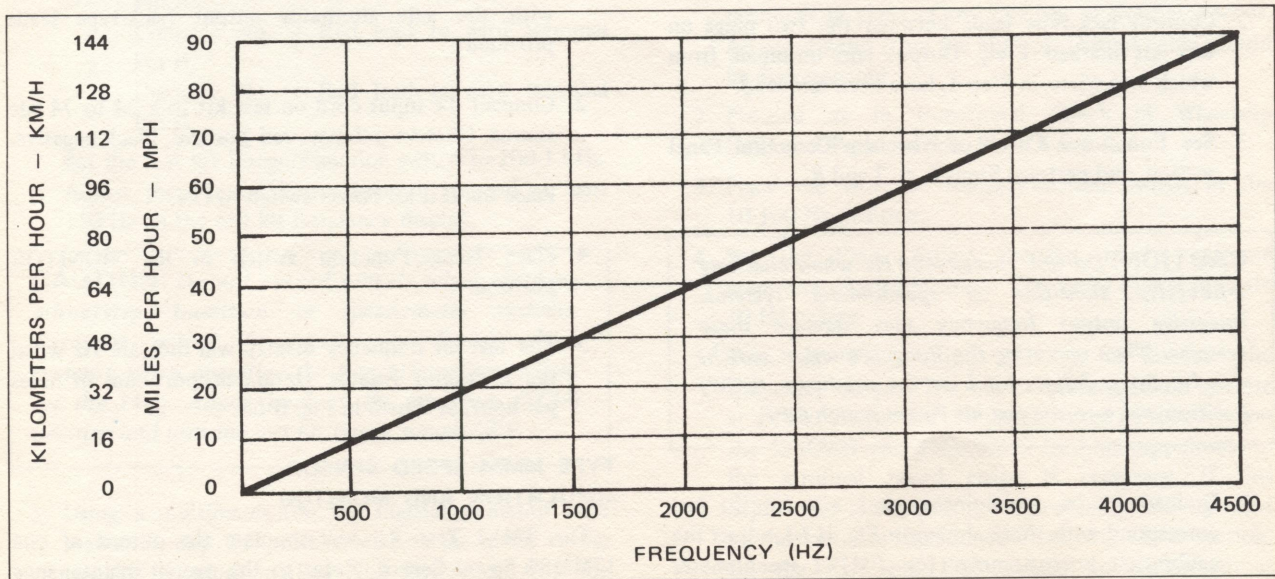


FIG. II-64. MPH VS. FREQUENCY FOR 17MM54 SPEED SENSOR (40-IN. WHEELS).

TURBO SPEED SENSOR MONITOR

Locomotives equipped with the CHEC excitation control system, monitor engine turbocharger speed with a turbo speed-sensor probe. The output of this probe can be monitored using the TM14 Test Kit. Refer to the overall maintenance manual for specific turbo probe output data.

To monitor output:

1. Connect TM14 Test Kit Signal Input terminals in parallel with the turbo speed sensor probe output. (See locomotive schematic for a convenient location to connect to turbo output circuit.)
2. Connect d-c Input cord on test kit to a 24 to 74 vdc source. Observe polarity; red positive, black negative.
3. Place the test kit Power switch to ON.

4. Place Range/Function switch in the MONITOR position.
5. The test kit Frequency (Hz) display will indicate Hz when the turbocharger rotates.

Relationship between turbo rpm and Hz.

$$\frac{\text{Turbo rpm} \times 2}{60} = \text{Hz}$$

or Turbo rpm = Hz x 30

NOTE: Turbo probe output at idle speed may not be enough to trigger the TM14 Test Kit counter circuitry. This would tend to indicate no output, when in reality there is output. Try higher speeds to verify probe output.

NOTES: